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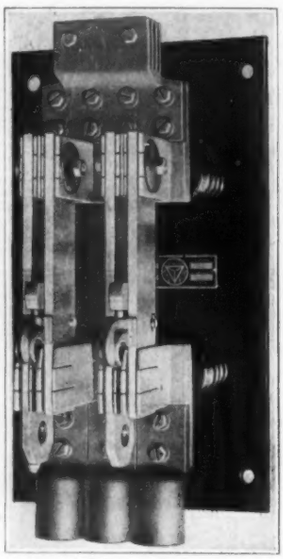

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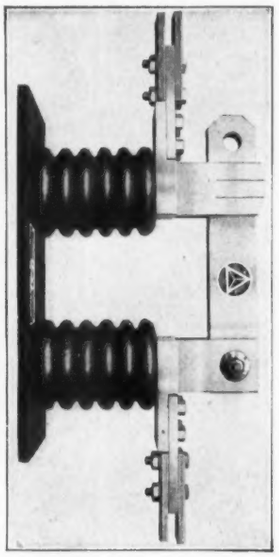

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 77 New York, Saturday, January 8, 1921 *Number* 2

Interesting the Lowly in Investments

HENRY L. DOHERTY has embarked on a thrift advertising campaign which is noteworthy. Much might be said for or against the copy appeal of "Personal —but Not Confidential"; but we are not here concerned with the execution so much as with the motive. The admonition to save is always in order and when followed ends in profit. What is of consequence to the industry is that Mr. Doherty advises that the savings be invested in public utility securities. His appeal, moreover, is more altruistic than selfish, for he does not press the prospective investor to come to him or invest in the securities of his companies. "Go to any investment banker for counsel and advice," is the burden of his message, and, of course, every investment banker and public utility operator gains, if only indirectly, whenever a convert is made for public utility investments. In this respect the advertising campaign is like the quality of mercy, "it blesses him that gives and him that takes." Mr. Doherty is to be commended for his enterprise and his initiative, his faith in the industry, and withal his belief in the efficacy of advertising.

Financial Burdens and Low Rates

LAST week our statistical department submitted an estimate of the requirements of the electric light and power industry for the next four years. This forecast was predicated on the past performance of central electric stations and the actual, not the theoretical, cost of their equipment. If the rate of growth continues as it has during 1920 and the fourteen years prior to it, the electric light and power companies must spend on a conservative basis a billion dollars a year for new developments and extensions to existing systems. Whether it can raise that amount of new capital in addition to meeting maturing obligations is problematical on present rate schedules. There would be no doubt of the outcome if earnings were ample, but if that consummation is to be reached either labor and material costs must come down or rates must go up. It is idle to imagine that the industry can continue much longer on the present basis, temporizing with coal clauses and what not, when straight increases are not only essential but imperative. Managers may not like to face the issue, but it is futile longer to dodge the facts. Nothing entering into the manufacture of electricity has been reduced in cost during the past five years. Everything has gone up in price, but the average charge for the electricity produced has hardly budged from the pre-war basis. A few mills have been timidly added here and there when nothing short of cents would avail. It is time to forget self-pity, and if the wind is not tempered to the shorn lamb, then the lamb must accumulate enough fat to keep it from freezing. It is senseless to sacrifice one's self on the altar of public service needlessly. The electric light and power companies of the country should simplify their rate schedules and increase them at the same time.

Bushwhacking Politicians and the Utilities

POLITICIANS when sore beset often try to evade their pursuers by drawing a herring across the trail. Sometimes they succeed and sometimes they do not. Investigations now under way in New York City reveal the city administration in any but an enviable light. Ignorance and inefficiency are its chief characteristics. The situation reminds one of the story of a chef who while he made excellent doughnuts was an abominable cook. His soups were greasy, his meats tough and his vegetables soggy. On being reprimanded for spoiled and indigestible meals, the chef was able to point with pride to his doughnuts and save his pate. When, however, the magic of his doughnuts wore off and his menus finally became intolerable he was discharged. The public utilities of New York City, groaning under many years' burdens of rising costs, have applied to the Public Service Commission for relief, and in most instances increases in rates have been granted to them. Immediately the city administration, goaded to desperation by the Lockwood committee tries to shift the public viewpoint by attacking the utilities and the commission which granted them the increased rates. We doubt, however, if the herring is strong enough to throw the public off the scent. The administration may pride itself on the way it has whacked the public utilities, but that can hardly suffice to appease the public wrath. The doughnuts may be fine, but the major portion of the meal will not down.

Getting the Facts for Engineering Solutions

ENGINEERING attack upon his problems is given as the reason for Herbert Hoover's success in handling the tremendous task of feeding Europe. The engineering point of view is more and more held to be necessary for the proper solution not only of engineering problems but also of many others. It seems to give the most rational promise for bettering living conditions. "Get the facts first, then propose the solution," should be the rule. A survey of the transmission and distribution systems of the nation shows that there is need for the application of more consistent and thorough engineering. The mechanical structure has received much consideration, the electrical design has not been neglected, but to the economical design has not been given its due share of thought. Design in each one of these three classes, mechanical, electrical and econom-

ical, is necessary to successful results. The most economical line consistent with good service should be the end sought by the engineer in transmission and distribution layouts. The working out of this principle is the object of a series of articles on the application of engineering economics to the problem of transmitting electrical energy from the central station to the customer, the first installment of which is printed in this issue of the ELECTRICAL WORLD. This week's article is devoted to the general methods of engineering attack upon these problems. The correct point of view is emphasized, and the methods of getting the facts are outlined. With the ever-growing realization of the value and necessity of conserving our national resources, this discussion of economical principles applied to a branch of electrical work that has been somewhat neglected should prove timely.

Power Transmission at 220,000 Volts

TRANSMISSION at 220,000 volts will be brought into the realm of actuality at a very near date. The subject has been up for several years, growing in interest with the realization that something superlative in the way of voltage is necessary for the larger work of long-distance transmission. In the ELECTRICAL WORLD last week Messrs. Barre and Jollyman, engineers respectively of the two greatest California transmission systems, laid down the plans now under way for the next advance in voltage. Both the Southern California Edison Company and the Pacific Gas & Electric Company are facing situations where this radical step seems necessary. The former within a year or two will find the Big Creek 150,000-volt lines fully loaded, and before the stations can be further strengthened something will have to be done for the lines. Two new 150,000-volt transmission circuits would double the capacity, but the same thing would be accomplished at less than 20 per cent of the cost by increasing the present line voltage to 220,000. The latest equipment has been ordered with this transmission voltage in view—a generator capable of controlling the voltage on a 220,000-volt line when backed up at the far end by a 30,000-kva. condenser. The transformers can be connected for 220,000 volts, and a 30-mile section of one of the existing lines is being set apart and equipped for insulation tests. When certain practical questions have thus been settled a part or all of the main line is to be changed over.

There are several possible schemes for raising the voltage, choice among which will be made in accordance with the information derived from the experiments. The whole main transmission of 240 miles will probably be involved in the final change at no distant day. The Pacific Gas & Electric Company has also a transmission line of about the same length from its Pit River plant, with an ultimate capacity of 450,000 kva., to the districts along San Francisco Bay. The investigation of the economic conditions shows very clearly that 220,000 volts is fully justified for the work in hand. The obvious difficulties of dealing with such a voltage are the requirements for transformers, for circuit breakers, for insulators, and finally for means of dealing with the increased capacity and charging currents. Long experience with a solidly grounded neutral on the high-tension lines has brought conviction that the same plan should be carried out at 220 kv. The transformers will actually involve less insulation difficulty than some of those now in use on delta connection, and it is believed that the bushing problem has been successfully solved. The matter of circuit breakers deserves serious consideration, particularly with reference to the circumstances of their use, a study of which may lead ultimately to less strenuous requirements. The line voltage seems well within grasp as regards its insulation, but certainly the grading question should have the most thorough consideration before determining on the ultimate methods to be adopted. The charging current must undoubtedly be dealt with by means of synchronous condensers, or their equivalent, at the receiving end of the line. A 200-mile, 60-cycle, 220-kv. circuit requires more than 40,000 kva. charging current, which emphasizes the importance of condensance in one form or another. The first Pit River unit will be in operation by the end of the coming year, and that period will probably be marked by the actual initiation of the first commercial 220,000-volt line on one or the other of the great California systems that are here concerned.

The Growth of Industrial Motor Service

IT IS no small task to make a census of the industrial load served by central stations, but we believe that we have reached a fair measure of success in the work, the results of which we presented to our readers last week. The data accumulated cover the five years ended with Dec. 31, 1919, and show with extraordinary force the fundamental nature of the central-station industry as related to manufacturing. In 1919 there was sold to power users more than 22,000,000,000 kw.-hr. The use of power increased with particular rapidity during the war, but the causes underlying that increase are still operative, and unless the costs of fuel and of labor should change in a way altogether unexpected, a power demand of more than 30,000,000,000 kw.-hr. by the end of 1924 can be foreseen. In 1914 only 7,500,000,000 kw.-hr. was sold to power users, so that the decade involved will foot up to a fourfold increase.

The load thus gained is very unevenly distributed, bearing perhaps a closer relation to the completeness of electric distribution service than to anything else. This fact in turn shows that the chief hindrance to rapid growth of power load is in facilities for distribution and not in the legitimate demand for power. Such an upheaval in fuel costs as the last few years have seen will not subside for many years to come, if ever. It has completely upset the old balance between central-station service and privately operated plants. The cases in which the latter show any real economy are now so rare as to be almost negligible in the totals. Generation and distribution on a large scale give an advantage not only in first costs of energy but in diversity factor that is hard to overestimate. If the prosperity of the country goes forward, as there is every reason now to hope that it will, unimpeded, and the power projects now on foot are to a reasonable extent carried through, we are inclined to think that our estimate for the end of 1924 will fall materially short of the tremendous truth. The public has rapidly learned the advantages of central-station power under the stress of the last five years, and that factor in the situation cannot be evaluated in the discussion of mere statistics. It is time to be up and doing with power supply on a scale never before attempted.

Improved Power-Station Design Makes for Economy

OUR brief résumé of power-station design last week, prepared by Peter Junkersfeld, expresses with admirable conciseness the general drift of improvement. Stations today must be designed for high efficiency, and while there is a possibility that the fuel situation may relax it is very doubtful whether costs will ever again fall low enough to give an economic advantage to cheap plants of low efficiency. First cost may be at times burdensome in its addition to general expense, but with fuel 75 or 80 per cent of the cost of production capital charges where they signify improvements for real efficiency are well justified. Nevertheless, every care should be taken to make a dollar do a dollar's work, and the drift of practice leads directly toward this result.

The use of boilers of much greater capacity than those employed a few years ago has been accompanied by a realization that the furnace as much as the boiler plays an important part in efficient operation. Recent practice sets boilers particularly high with ample furnace space, and there is a healthy tendency to plan furnaces and stokers for readily available fuel rather than for the high grades of much-traveled steam coal which used to be considered necessary. Oil burners have been materially improved, but, as we have many times suggested, their use is special rather than general. The only point where Mr. Junkersfeld's paper shows practice to be lagging is in the matter of auxiliary appliances, like economizers, tending materially to promote efficiency. Designers have shown an inclination to avoid the constructional difficulties in economizers by adopting things easier to build but which do not perform quite so well in the matter of heat recovery. We think that constructors will have to take their medicine in this matter, just as they will be forced to do in superheating —a point in which American practice has been particularly slow to improve.

In electrical equipment as in boilers the tendency has been toward the bigger units and more substantial, somewhat simplified equipment. The accidents of a few years past have impressed upon the minds of engineers the need of blocking destructive short circuits and in particular installing means for cutting out an internally damaged generator before it can wreck or upset the station output. Finally, it is to be noted with satisfaction that all apparatus which can be successfully designed for outdoor installation is being located out of doors. We have been preaching outdoor substation work for the last decade despite the wagging heads of ultra-conservatives, and it is a pleasure now to be able to see the practice becoming general.

Where Fuel Should Be Conserved

ADVERTING to the general questions of conservation, so vigorously discussed by the American Society of Mechanical Engineers recently, it is undoubtedly true that our natural gas is going fast and that oil is fairly on the road. Over and over of late we have discussed the question of fuel-oil burning, always with a solemn warning that the impending scarcity is likely to make it uneconomical. What the government can do in this very serious situation is a little hard to say unless it can establish more rigid regulation of the quality of the fuel produced or can steady the production of the coal mines, which now are run chiefly on the principle of waiting until orders are received and then hustling.

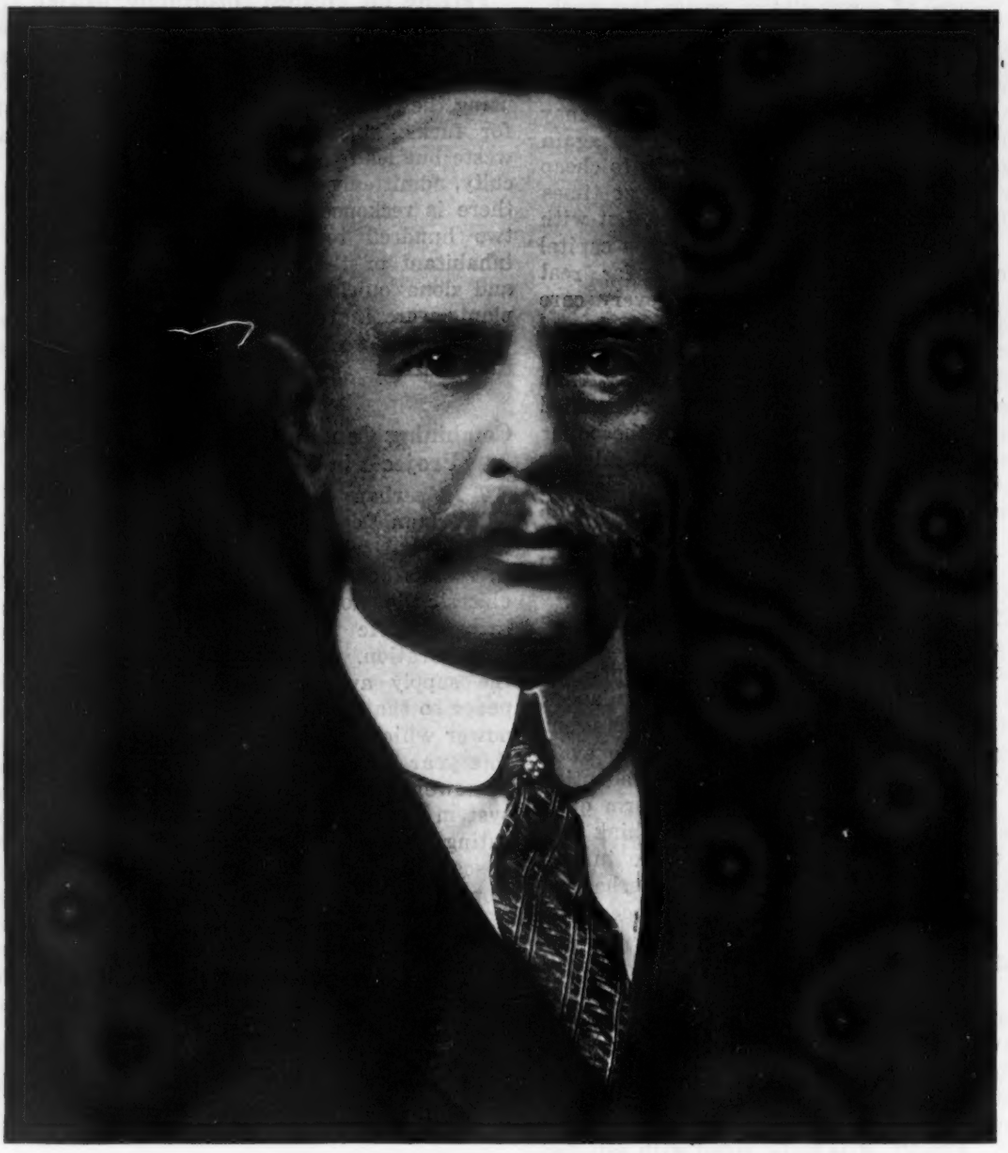
Perhaps the greatest opportunity, looking at the subject in the large, lies in the better utilization of coal through separating the volatile from the solid carbonaceous material by low-temperature distillation, using the former for byproducts and gas and the latter for fuel. This may ultimately not only save great waste but lead to a solution of the domestic fuel difficulty, admittedly very grave. Considering the fact that there is reckoned to be within known reach less than two hundred tons of unmined anthracite for each inhabitant of the country, something should be done and done quickly. If domestic heating and private plants were in the least comparable in efficiency with central-station working, there would be far less fear for the future.

Combining Canal and Power Projects in Germany

IT IS perhaps putting it too strongly to say that the German Republic is beating its cannon into waterwheels, but with the coming of peace, such as it is, there has been an awakening with respect to hydroelectric developments. Three combined canal and hydro-electric projects are in fact just now under consideration. Germany is far from rich in coal, and the supply available is cut down by the terms of peace so that use can be found for all the transmitted power which can be generated. At the beginning of this year the electrical industry was nationalized by empowering the state to take over any transmission system above 50,000 volts or exceeding 5,000 kw. in rating not already in use exclusively for private purposes. The indication is therefore that the German Republic will in the near future possess the entire high-tension system and be able to carry out a complete project of interconnection. The schemes now under way are technically of more than usual interest since they are in the main bound up with canal projects. The German rivers are extensively used for minor shipping purposes, long stretches of them being provided with mechanical haulage with this object in view.

One of the projects is on the Neckar, allowing an extension of the Rhine marine traffic over nearly 150 miles (240 km.), with the utilization of 5,650 cu.ft. (160 cu.m.) of fall a second. Another is a revival of the Rhine-Danube canal project long ago considered, and a third involves canal construction on the Moselle and the Saar. It is not easy to realize that the extreme headwaters of the Danube are in the Black Forest country within 25 or 30 miles (40 km. or 50 km.) of the Rhine, but such is the fact, and through parts of Bavaria canal navigation in the line of the Danube might be practicable.

While the economic outcome of the several schemes seems somewhat doubtful, yet in part at least the utilization of streams for the double function of navigation and power might succeed through the combination of these utilities, which alone would not find sufficient justification. The total amount of power available by the full development of these schemes runs high, to something like 10,000,000,000 kw.-hr. annually. None of the projects is as yet far enough advanced to be seriously disclosed in engineering details.



Louis Bell

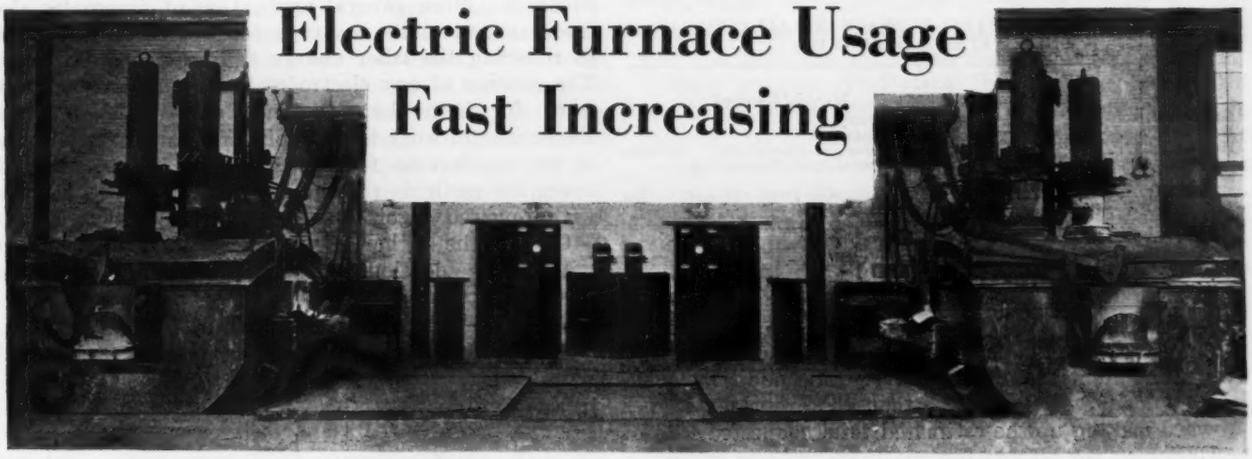
Publicist and author; a consulting electrical engineer of international reputation who in his pioneer work laid the foundation for the later progress that has been made in electric power transmission and in illuminating engineering

MOST consulting electrical engineers engage in a designing and construction practice as well, but there are some who devote their time purely to consultation. They are to the electrical industry what eminent consulting physicians are to the medical profession. Among those who have achieved well-merited recognition in Europe as well as in the United States is Dr. Louis Bell, who for the past twenty-five years has been engaged in consulting engineering practice in Boston.

Dr. Bell was one of the first to give scientific and engineering attention to illumination. He is a charter member and past-president of the Illuminating Engineering Society and a past vice-president of the Illuminating Engineering Society of Great Britain. For years his book on the "Art of Illumination" was the only available volume on illuminating engineering. Furthermore, Dr. Bell for the last thirty years has been one of the largest and most respected contributors to the engineering literature of the industry. Besides the volume on illumination he has written "Electric Power Transmission," for years the standard treatise on this subject; "The Electric Railway" (with Oscar T. Crosby), the first systematic treatise on the subject, and "Power Distribution for Electric Railways," which has gone through a number of editions. The subject, however, to which he has given most attention and on which his work is probably best known is power transmission. He lectured on that subject at the Massachusetts Institute of Technology for ten years, and he was secretary of the power transmission section of the International Electrical Congress at St. Louis in 1904. He was editor of the ELECTRICAL WORLD from 1890 to 1892, when he resigned to become chief engineer of the newly organized power transmission department of the General Electric Company. In this capacity he designed and installed at Redlands, Cal., in 1893, the first three-phase transmission plant for general service and installed the first polyphase transmission plant for cotton-mill drive and for electric railway operation at Taftsville, Conn. His pioneer work in the early '90s in power transmission and in the development and application of the induction motor was of the greatest importance in placing these branches on an engineering and commercial basis. Before the war he conducted abroad investigations of electric lighting and central-station practice in Europe.

Dr. Bell was born Dec. 5, 1864, and was graduated from Dartmouth in 1884. Four years later he received his doctor's degree from Johns Hopkins University, where he had specialized in physics. That year he went to Purdue University, where he organized the course in electrical engineering. In addition to his very active work in the electrical field Dr. Bell finds time for studies in other lines, chiefly in relation to ordnance.

Electric Furnace Usage Fast Increasing



More than 220 Non-Ferrous Furnaces Installed During 1920—Total Connected Furnace Load Estimated at 880,000 Kva., of Which 410,000 Kva. Is in Commercial Furnaces—Electric Steel Output Reduced

ONE of the very striking features of electric furnace develcpment in the United States during the past year has been the rapid rise of the non-ferrous furnace to a prominent position. This year's survey made by the ELECTRICAL WORLD shows that more than 222 non-ferrous furnaces were installed during 1920, adding a connected load of 24,405 kva. to the energy requirements of the country.

Steel furnaces have not maintained the pace set in the banner year of 1918, when ninety-seven installations were added, the past year showing an addition of only fifty-two installations, with a capacity of 183¾ tons, calling for 50,440 kva. in transformers.

On Jan. 1, 1920, it was estimated that a total of 491 furnaces of all classes were installed in the United States, of which 62 per cent were steel furnaces, 35 per cent non-ferrous furnaces and 1.5 per cent reduction-of-ore furnaces, while the remaining 1.5 per cent were used in special processes. The first of 1921 sees the situation somewhat changed, with an addition of 274 commercial installations, making a grand total of 765 furnaces in the United States. There are no records available of the changes in the number of special process furnaces, not listed as commercial furnaces, but it is probable that the number was small. Based on last year's totals and this year's additions (see Tables I and II) 356 steel furnaces, or 46.5 per cent of the total, and 394 non-ferrous furnaces, representing 51.5 per cent of the total, are installed. The 2 per cent left represents, as far as is known, the number of special furnaces.

TABLE I—NON-FERROUS FURNACE GROWTH HAS BEEN RAPID, JUDGING BY 1920 INSTALLATIONS

Name	No.	Total Tonnage	Total Kva., Approx.	Material Handled
Ajax Wyatt (induction)..	96	30 hourly	5,760	3 Red brass 93 yellow brass
Bailey (resistance).....	55	368 —24 hour capacity	5,075	Red and yellow brass, bronze, aluminum, glass, zinc, tin
Booth (rotating).....	40	½ to 2	6,530	Principally brass
Detroit (rocking).....	20	20 hourly	5,475	Bronze, brass, copper, aluminum, gray iron
Rennerfelt (three-phase)	7	2	875	Nickel alloys, silver, bronze, aluminum, yellow brass
Snyder (single-phase)....	2	600 lb.	160	Monel metal
Snyder (single-phase)....	1	1	450	Bronze
Snyder (single-phase)....	1	300 lb.	80	Bronze
	222		24,405	

The 750 furnaces represent a connected load of 410,000 kva., which does not take into account the special furnaces for which no definite records are available. It is stated by an authority that the aluminum production for 1920 was 150,000,000 lb. with an energy requirement of 1 kw.-yr. for each 400 lb. produced. On a basis of a 100 per cent load factor and twenty-four-hour daily operation, a reasonable assumption for this process, this would call for 375,000 kva. transformer capacity. The aluminum industry is said to make up 80 per cent of the special furnace load. An estimate on this basis of the total special requirements would indicate a load of 470,000 kva. The entire electric furnace load of the country would therefore be placed at 880,000 kva.

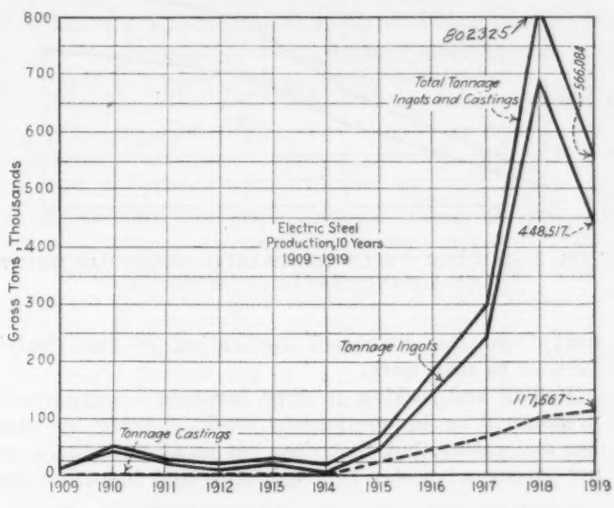


FIG. 1—TOTAL ELECTRIC STEEL PRODUCTION, INGOTS AND CASTINGS, FOR PAST TEN YEARS

In the year 1919, as shown by last year's survey in the ELECTRICAL WORLD,* ninety-two brass-furnace in-

*Jan. 17, 1920, issue.

TABLE II—ELECTRIC STEEL FURNACE INSTALLATIONS IN UNITED STATES DURING 1920

Name	No.	Total Tonnage	Kva. Approx.	Material Handled
Gronwall-Dixon	13	53	17,500	Scrap.
Booth	2	4	1,600	Steel scrap
Heroult	11	40	10,000	Three manganese-steel castings, three ingots, four castings
Snyder	6	13½	7,290	
Rennerfelt	5	1½	725	High-speed steel, soft steel testing
Moore	4	9¾	3,450	Castings
Ludlum	3	19	5,375	Castings, Tool Steel
Webb	2	7	1,600	Steel
Greaves-Etchells	6	6	2,900	Castings
	52	153¾	50,440	

stallations were made, while in the year 1920 there were 222 additional installations. The additional connected load of 24,405 kva. that this represents goes toward making up the estimated total connected load of 50,000 kva. for all non-ferrous furnaces now operating in this country.

Probably one of the principal reasons for this unusual growth has been the recognition of the value of electric melting of brass. It would be a conservative estimate to state that at least 75 per cent of furnaces of this type are working on red and yellow brass, while the other 25 per cent of installations are melting tin, aluminum, copper, nickel alloys, zinc, tin, glass, etc.

Many reasons have been advanced why the electric furnace is gaining ground in the brass foundry, but probably those of ease of temperature control and uniformity of product are deciding factors. That the basic reasons have been verified in practice is very evi-

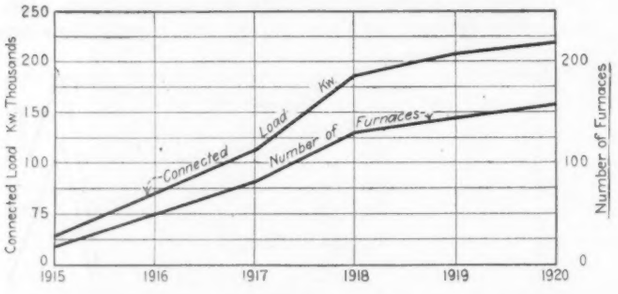


FIG. 2—ELECTRIC STEEL FURNACE DEVELOPMENT HAS MEANT A LARGE INCREASE IN CONNECTED LOAD

dent from the continued application of the electric furnace to such work.

Rolling and rocking arc-type furnaces are apparently predominating in non-ferrous work, judging by number and rating, but that does not mean that there are not strong advocates for resistance and induction-type furnaces. More general application of automatic electrode control to the arc-type furnace has been helpful in reducing the labor charge against the arc furnace. The absence of any electrodes has been a strong argument for both the resistance and induction types. Experimental work is still going forward with all types of the non-ferrous furnace, and with improvements in operation methods the field will no doubt be attacked with renewed vigor during the coming year.

One of the rather interesting points in connection with furnace development has been the demand for this

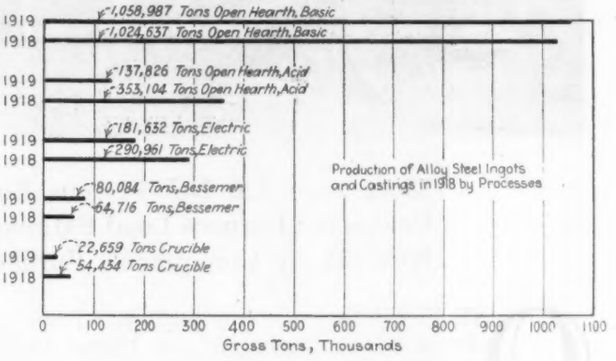


FIG. 3—ALLOY STEEL PRODUCTION BY PROCESSES FOR 1918 AND 1919

As shown by these curves illustrating the growth of the Heroult furnace, the number of furnaces and the connected load has assumed large proportions.

equipment in other countries. About fifteen equipments were sold abroad. Bailey furnaces went to the following countries: Norway, two for zinc; England, one for brass; Mexico, one for brass; Japan, one for brass; Canada, three for brass. Shipments of the Rennerfelt furnace were made to: Colombia, one for silver; Java, one for ore reduction; Sweden, one for tool steel. The Detroit furnace installed three furnaces in Japan and one in France.

TONNAGE OF ELECTRIC STEEL WILL PROBABLY SHOW DECREASE FOR 1920

While no authentic figures are yet available to show the production of electric steel during 1920, it seems to be the consensus of opinion that this year will be a decrease in output, not because of lack of advantages but owing to market conditions. As shown in Fig. 1, the production of steel by electric processes during 1919 decreased 236,241 gross tons from the year 1918, when the output was 802,325 gross tons. The output in 1919 was 566,084 tons, and in all probability it will not exceed 450,000 tons during 1920.

TABLE III—ELECTRIC STEEL AND TOTAL STEEL PRODUCTION IN UNITED STATES (GROSS TONS)

Year	Open-Hearth	Bessemer	Steel Ingots and Castings—Crucible	Steel Ingots and Castings—Electric	Steel Ingots and Castings—Miscellaneous	Alloy Steels Open Hearth, Bessemer, Crucible	Alloy Steels Electric	Total Production	Per Cent Electric
1909	14,943,936	9,330,783	107,355	13,762	9,185	.....	.....	23,955,021	0.58
1910	16,504,509	9,412,772	122,303	52,141	3,194	.....	.....	26,094,919	0.2
1911	15,598,650	7,947,854	97,653	29,105	2,844	.....	.....	23,676,106	0.123
1912	20,780,723	10,327,901	121,517	18,309	2,853	.....	.....	31,251,303	0.058
1913	21,599,931	9,545,706	121,226	30,180	3,831	.....	.....	31,300,874	0.096
1914	17,174,684	6,220,846	89,869	24,009	3,662	.....	.....	23,513,030	0.102
1915	23,679,102	8,287,213	113,782	69,412	1,527	.....	.....	32,151,036	0.216
1916	31,415,427	11,059,039	129,692	168,918	604	.....	.....	42,773,680	0.395
1917	34,148,893	10,479,960	126,716	304,543	495	.....	.....	45,060,607	0.675
1918	34,459,391	9,376,236	115,112	511,364	329	1,496,891	290,961	46,250,284	1.74
1919	26,948,694	7,271,562	63,572	384,452	2,952	1,299,556	181,632	36,152,420	1.59

*Estimated

The extraordinary increase in use of electric steel furnaces was due in large part to war orders and the greater demand for electrical steel. No doubt the application of the electric furnace to making steel ingots and castings was advanced several years by the war. Nevertheless, the growth of this furnace business was in a very healthy state during the past year, and when production of steel is again pressed to the maximum the tonnage output of electric steel should reach surprising figures. Electric steel has become a staple product, and its quality and uniformity are effective arguments in keeping it one.

The electric furnace is becoming an important factor in power loads. The past year saw the addition of 47,970 kva. in steel furnaces, and yet the growth was probably not normal. The Heroult furnace alone has added 216,900 kw. in connected load, most of which has been added since 1915. It is estimated that the total electric furnace load in the United States is 360,000 kw., so it can be seen that the Heroult furnace dominates the electric steel business.

During 1920 the patent rights of the United States Steel Corporation on the Heroult furnace expired. Possibly this fact will tend to stimulate the production of electric steel by independent manufacturers who have heretofore had to operate under license rights if Heroult furnaces were used.

As shown in last year's survey, the total number of steel furnaces in the United States was 304, and with the installations of 1920 the total is 356.

There are now 174 Heroult furnaces installed, 156 of which are in the United States and the remainder in Canada. Of these 174 steel furnaces 100 are used for making ingots and seventy-four for steel casting, while three are used in miscellaneous works. The predominating size of furnace is the 6-ton rating, of which there are ninety-three in operation. The next size in popularity is the 3-ton rating, thirty-three of these having been installed. There have been only two of the largest, or 35-ton, size installed.

The predominating sizes of steel furnaces during 1920 were below 6 tons, the average being about 3 tons, although the Ludlum Furnace Corporation installed a 10-ton furnace for melting scrap.

About 75 per cent of the non-ferrous furnaces ranged around the 500-lb. capacity size, although a number of 1,000-lb. and 2,000-lb. (450-kg. and 900-kg.) furnaces were installed. As the majority of these furnaces are melting brass, which, except in the large foundries, is needed only in small quantities at a time, the small furnace is adapted for the work. There were ninety-six installations of the Ajax Wyatt furnace, ninety-three working on yellow brass and three on red brass. The total hourly capacity is 60,000 lb. (27,000 kg.).

Economics of Electrical Distribution

Application of Fundamental Underlying Principles to the Problem of Transmitting Electrical Energy from the Central Station to the Consumer—Indicates How the Most Economical Installations Consistent with Good Service Can Be Determined

By P. O. REYNEAU* and H. P. SEELYE†
Detroit Edison Company

TRANSMISSION and distribution systems represent a large part of the total investment in any central station, but their study from an economic point of view has seldom had sufficient attention. It is true that much valuable information may be found scattered through engineering literature, but there is a need of bringing together the factors involved in such a study and of discussing the subject as a whole. With this purpose in mind the authors have prepared a series of articles based on studies of actual problems encountered in practice. It is fully realized that this series cannot cover in detail the field of distribution and transmission economics, but it is hoped that the presentation of the fundamental underlying principles and the solution of a few problems will serve to indicate methods that can be applied quite generally to such problems.

WHAT CAN BE OBTAINED FROM APPLICATION OF ENGINEERING ECONOMICS

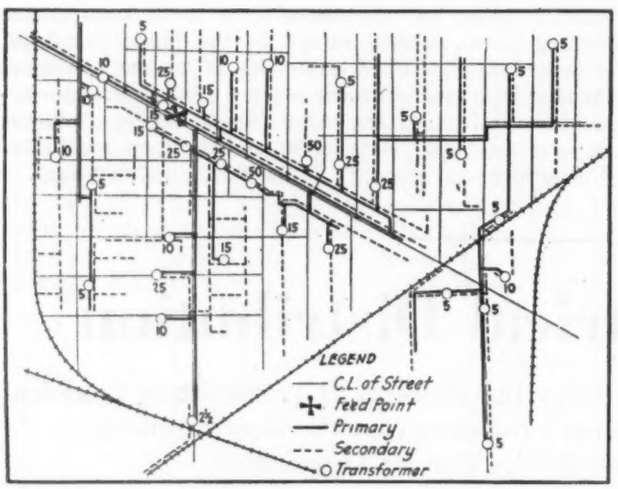
The results obtained are made obvious by comparing the two figures and by glancing at Table I, without going into the detailed computation required to ascertain the most economical design. An example of such computation will be given later. The table shows that with a smaller investment, reduced inspection and testing requirements a larger load can be carried. Neither is it within the scope of this series to consider unusual problems, such as transmissions at very high voltage, for example, or installations of special apparatus the use of which has not become accepted practice. Rather, the general purpose will be to make a few analyses that will indicate methods of finding the most economical design under every-day conditions with material of known characteristics and at known prices. Such analyses will, naturally, not only indicate the most economical installation with materials and construction methods already in use but will make it possible to determine where any economy can be effected by changes in these methods or materials.

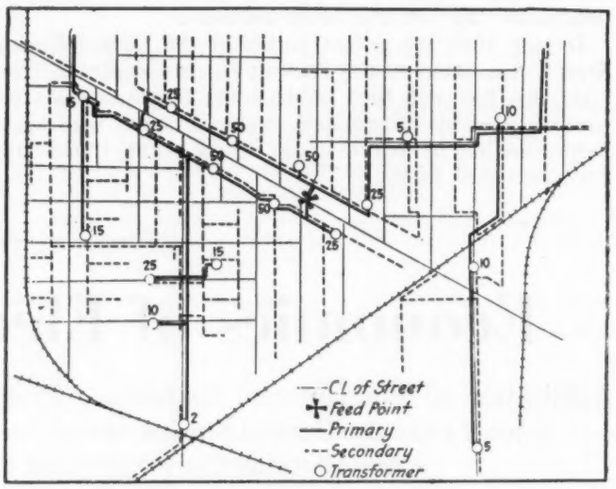
It is hoped that the methods presented will, on the one hand, show the magnitude of the savings possible by the use of engineering economics and, on the other hand, will be found simple enough in their application to be considered worth using in many places where more empirical or rule-of-thumb methods are used today.

Practically all problems of engineering design require for a complete solution treatment in three distinct stages. At first all the data must be obtained that can be determined with exactness. Such elements as mate-

*Distribution Engineer. †Distribution Department.

rial costs, strength of parts of construction, load tests, etc., are here included. Second, those elements which are not subject to exact measurement or computation must be decided upon. These are usually a development from practical experience over a number of years and are often matters of accepted standard practice. They are such items as probable increase in load, allowable voltage regulation, safety factors, standards of construction, etc. Empirical methods must here be employed. The third element is the most intangible—the good judgment of the engineer based on his knowledge and experience and applied to the particular problem in hand to utilize the first two elements so as to create an efficient and economical design best adapted to the situation. All these elements in their proper proportions are equally important in attaining the most satisfactory solution for any problem. Empirical methods, if applied blindly, may lead far away from the purpose for which they were originally intended. Judgment based on experience alone is liable to become a mere guess unless supported by exact knowledge and good practice. It would appear, therefore, that the further the exact data can be carried in a problem the less dependence need be placed on the more intangible elements, and hence the greater certainty of the best solution. The extension of this exact knowledge is the chief purpose of the study of the economic features of a problem. In many cases economy may be made the deciding factor between two or more designs apparently equally good from other points of view.





FIGS. 1 AND 2—A TYPICAL CIRCUIT IN THE SYSTEM BEFORE AND AFTER IMPROVEMENT

EXACT DATA

For any given system there are a number of limiting conditions which reduce the unknown factors in the design. There are certain standards, such as transformer sizes, wire and cable sizes, etc., which are established by the manufacturer. Other limitations are established by the accepted good practice of the profession in general. Moreover, each company has certain standards of materials and construction to which it is wise to adhere unless there is a clear advantage in making a change. The most complete information obtainable on all such data relating to the particular system in hand should be kept available for ready reference. Other items which can only be obtained exactly for the one locality or company, such as costs of material, labor and energy, should be determined as accurately as possible and be revised from time to time to conform to changing prices, wage scales and costs of production. This information can be readily kept up to date and tabulated or drawn up in curves. Then only such factors as are inherent to the particular line itself need be determined in making the design.

EMPIRICAL DATA

Some of the empirical elements of the problem of transmission and distribution of energy are worthy of considerable attention. One of these is the element of "good service." It is understood that in any design or layout the greatest economy "consistent with good service" is the object. Just what is good service may be a matter of considerable question.

Good Service.—Good service is not dependent on the ideas of the engineer or the "server" as to what it should be. Service is good when it satisfies the one that is served. That man who at the receipt of his bill feels that he has received all that was due him is receiving good service. He is willing to exchange his money for what he has received from the server.

The human element is therefore the most important one in determining good service. Customers will expect operating conditions as good as or better than they have been in the habit of getting. Companies have, so to speak, educated their public to certain expectations, and they must live up to such expectations. It is evident, however, that it is impossible to eliminate all interruptions or conditions of poor regulation. In thickly populated districts with a high load density practically continuous service at good voltage is easily given. In outlying, scattered districts the cost of the same quality of service would be prohibitive. From the company's point of view the service must be of good enough quality to

TABLE I—EXAMPLE OF ECONOMICS MADE POSSIBLE THROUGH APPLICATION OF PRINCIPLES DISCUSSED IN THIS SERIES

	Before Change	After Change
Number of transformers	35	18
Transformer capacity, kva	492	412
Available increased capacity in excess of peak load of 350 kw., per cent	0	20
Wire removed, lb.	8,500	....
Wire installed, lb.	5,600	....

insure earnings and yet not so good as to necessitate too large expenditures. It is therefore necessary, before attempting to solve a transmission or distribution problem economically, to ascertain what quality of service is required from both the customer's and the company's point of view.

Good service can therefore be determined only in a general way and will vary with locality, company, kind of load, etc. It might be said, however, that with the modern refinement of methods and equipment and the nearly universal high requirement of the customer we are approaching more and more a condition when wide variation of voltage and long or frequent interruptions will hardly be permissible.

Increase in Load.—A second quantity which must be empirically determined is that of load increase. The variation of loads to be carried and the growth of energy demand that is prevalent in nearly all localities

TABLE II—INTERDEPENDENT FACTORS TO CONSIDER IN STUDYING LAYOUT OF AN ECONOMICAL LINE

(1) Load	Location Present size Probable increase and rate of increase Characteristics: Phase requirements Power factor Variation, daily, weekly, seasonal, etc., and relation to station variations and peak Unbalance factor Maximum Load factor	
(2) Route of Line	Investigation of advisability of possible routes, affected by: Available pole or duct space Purchase of right-of-way Difficulties in construction Interference with or from other lines, physically or electrically Convenience of operation Possible future extensions Effect on system as a whole Cost as compared with other possible routes	
(3) Physical Constants	Length of line Spacing Voltage—desired —available Resistance of line Reactance Voltage drop Regulation—desired —available	Under various line conditions as limited by: 1. Good operation 2. Standard practice 3. Routing 4. Economical considerations 5. Good service
(4) Costs	1. Determination of: Labor costs Material costs Energy loss costs 2. Application of those costs to determine the best line for the purpose	For all conditions considered
(5) Relations to System	General considerations that may affect most economical line found above under (4) owing to its being a part of a large system Financial considerations	

are always matters for considerable study in connection with a layout. There are cases where it is possible to design for a certain demand that can be assumed to remain constant for a period of years, possibly for the life of some part of the equipment. Such would be the case in planning lines to a large power installation where growth could be taken care of by new circuits. On the other hand, such a load as house lighting increases continuously, and its increase can be estimated only from the figures for the past few years and general business conditions. In any case the design must be for a system that will be most economical over its useful life—in other words, when the sum of the annual costs for all years under consideration will be a minimum. It is further necessary to study as exactly as possible the number of years to be cared for by the present design and minor changes that can be made at various times during that period for taking care of the changes in load. Generally the design should cover the expected life of that part of the equipment whose life is shortest and which would require a large expenditure for its replacement. Any considerable change necessary to care for larger load could then be made at the same time with relatively smaller cost. In some cases, however, where the probable increase in load is more definitely known the economical life of the present design can be accurately determined even well within the expected life of all the important parts.

Financial Conditions.—The condition of the money market may be another determining factor in an economical design. Often the difficulty in securing necessary funds for a job may require the engineer to spend less at the time of installation than is consistent with economy over the period the design covers. However, the condition should be carefully considered in order still to obtain the best design as limited by the money available.

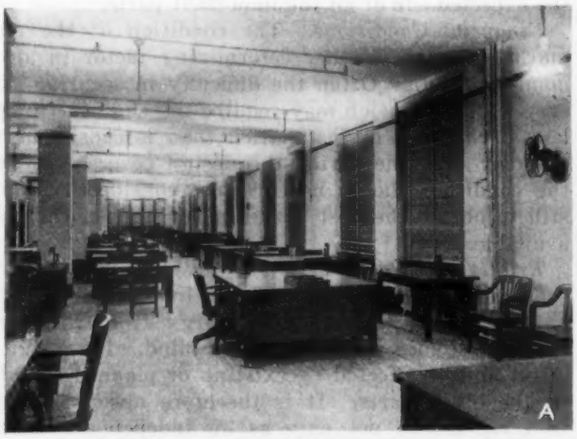
Relation of Parts to Whole System.—The fact that the transmission or distribution line is only one part of the system transmitting energy from the turbine to the customer must be kept in mind. Its design will affect and be affected by existing or planned conditions in the other parts. It is therefore always necessary to treat a line not only as an independent unit for some specific purpose but also as a working part of the whole system.

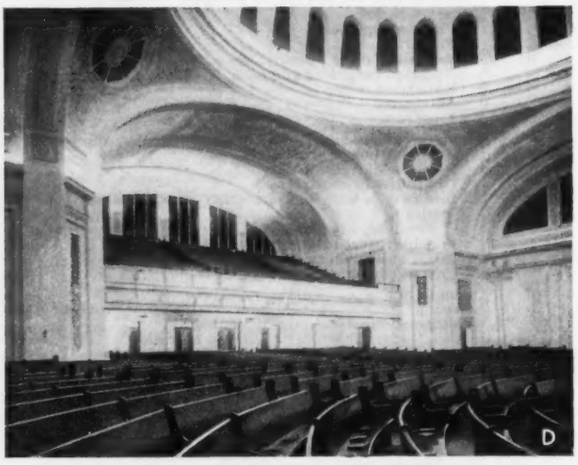
Bearing in mind the general considerations brought out above, the most important points to consider in studying the layout of an economical line can be determined from Table II. Methods of obtaining the data outlined and their application to particular classes of problems, such as transmission lines, power lines, secondaries, etc., will be discussed in future installments of this series. From inspection of this table it may be seen that the five divisions in it are in one way or another interdependent, so that each one must be considered in relation to all the others. It is only by a careful study of the problem from all angles and a co-ordination of results that a satisfactory solution can be obtained.

The articles which will be presented in later issues will take up means for obtaining and analyzing some of the most important data necessary for economic study; that is to say, the cost of material, labor and energy.

WE MIGHT *summarize our attitude toward investors in public enterprises in California by saying: We recognize your investment will result in common good. You are about to become a partner in an enterprise which will develop the community. We realize that the constitutions of the United States and of California and the laws enacted thereunder are designed to protect your investment against confiscation. We are in full accord with the spirit of these laws and propose to proceed in accordance therewith. Furthermore, we believe it to be sound policy and in the interest of the public that your investment be protected and that you be accorded reasonable returns thereon, recognizing, of course, that some risk attaches to all private enterprise. At the same time we inform you that you will not be permitted to make exorbitant profits nor will you be permitted to burden the consumers with poor service. Having said this to the investors, we should carry out our pronouncements honestly and consistently, not only as a matter of honor, but in the interest of the progress and development of the State.*—EDWIN O. EDGERTON, president California Railroad Commission.

Several Types of Lighting Which Are Giving Entire Satisfaction





A—Illumination is provided in this office without causing desk glare or eye fatigue from exposed brilliant filaments. The downward component of the light flux is directed through a softly diffusing medium, while the remainder of the flux illuminates the ceiling at about the same intensity as the fixture surface.

B—Fixtures which give combined indirect and diffused direct lighting are used in this drafting room, the usual objection to indirect lighting being offset by coating the ceiling with paint having a low absorption factor and practically no specular reflection. The units are hung low and relatively close together, thus giving relatively high and uniform illumination at the work.

C—In this shop direct-indirect lighting is used without employing the ceiling as the reflecting medium. Instead the upper surface of the fixture redirects the lights, the lower bowl diffusing the direct light.

D—Cove lighting, while relatively inefficient compared with other forms of lighting, is often more effective in emphasizing architecture and illuminating large interiors like this.

E—Gas-filled lamps, the brilliant filaments of which are shielded from vision, illuminates this press room.

F—The R.L.M. reflector is becoming very popular in industrial plants, where ruggedness must be obtained, but not at the expense of good illumination.

Significant Developments in Illumination During 1920

Cost of Poor Lighting Is Very High—Street Lighting Is Still Improving—Ocular Advantage of Higher Intensities Is Shown—Use of Color in Lighting—Remodeling Old Fixtures Proves Practicable—Automobile Headlight Progress

By PRESTON S. MILLAR
General Manager Electrical Testing Laboratories

ONE of the silver linings of the war cloud was the throwing into relief of fundamentals as contrasted with the unrealities and superficialities which had formed so considerable a part of the scheme of things. The necessity for economy in production emphasized the importance of correct practice and sound engineering, the value of which was further demonstrated by the too numerous instances of poor performance growing out of failure to observe these fundamentals. Among other things, the practical value of good illumination as an aid to economy through increased production and enhanced safety gained a recognition under war-time stress which it had therefore failed to secure. One of the most significant evidences of this was the action of the United States Fuel Administration in exempting industrial lighting from fuel restrictions and curtailments, upon the theory that a given production would be attained with good ample illumination and with less expenditure of fuel than would be required for the same production under poor and low-intensity lighting.

A recent engineering estimate from liability insurance statistics has indicated that the annual loss occasioned by accidents attributable to poor illumination is equivalent to the time of 108,000 employees for one year. This statement commands attention even from the sordid viewpoint which ignores the humanitarian impulse to conserve life and limb. It imposes upon industry a duty so to improve lighting conditions as to avoid a large part of this annual waste of resources. In 1920 not a little has been accomplished in this direction, both in the direction of education and in the direction of actual improvement in lighting.

One of the most notable achievements of the Illuminating Engineering Society has been its assistance to legislators in the preparation of lighting requirements for safety codes which are influential in promoting good industrial lighting and in insuring correction of the lighting conditions which offer the greatest menace. Necessarily indefinite with respect to some of the elements of illumination which are difficult of codification, measurement and enforcement, the lighting codes have made a promising start in these particulars and have gone a little farther in the prescription of minimum intensity values for safety purposes—a matter which it is now practicable to cover by stipulations and measurements and therefore possible to police.

While it is a duty of industry to provide illumination adequate for the protection of workers, it is further the opportunity and privilege of industry to provide more effective illumination with a view to promoting efficiency and securing economy through facilitating operations and reducing spoilage. Reports from many sources indicate that manufacturers who have tried superior lighting are invariably convinced of its economic value, finding the small added lighting costs to be more than offset by the production economies effected. Obviously definite cost accounting to measure the advantages of good industrial lighting is difficult to obtain. Such figures as have been put forward, however, leave no room for doubt of the actual value of good lighting in the industries. Good lighting means of course light which is correct with respect to direction, diffusion and color and which is of ample intensity—intensity well up toward if not of the same order as the daylight intensity common in well-lighted interiors. With such lighting brightness and brightness contrasts are of values which promote ready and comfortable vision, shadows are helpful, not obstructive, and glare is avoided.

BIG ADVANCE IN INDUSTRIAL LIGHTING

Good industrial lighting has made a considerable advance during the past year. The manufacturers of lamps and lighting equipments have promoted the idea vigorously and central stations have devoted more attention to its promotion than formerly. For instance, a paper presented at the annual convention of the Illuminating Engineering Society called attention to a central-station campaign in Massillon, Ohio, which had attained such momentum that approximately 70 per cent of the industrial lighting of the town was brought into accord with modern ideas of good and effective illumination. The promotion of good lighting by commercial interests—constructive in its very nature—is of marked advantage to the industry of the country.

In the field of experiment a timely contribution has been made by C. E. Ferree and Gertrude Rand* to the literature of illumination by means of a report upon researches in the psychological laboratory at Bryn Mawr College. When illumination intensities are increased throughout and up to about the highest intensities contemplated for artificial illumination the eye's reaction is wholly favorable. Without any evidence of discomfort or strain there results increase in visual acuity, increase in speed of visual discrimination, increase in speed of adjustment for vision at different distances and increase in ability to sustain acuity. Furthermore, these experimenters find that whereas under low intensities of illumination astigmatic and aged eyes suffer diminution in effectiveness more than do normal eyes

*See ELECTRICAL WORLD, Nov. 6, 1920, page 910.

under relatively high intensities the disparity is less pronounced, so that the handicap of subnormal vision is of lesser consequence under high-intensity illumination. This experimental work, partly confirming general observation and partly supplying new data from which to deduce conclusions, offers a scientific basis for explanation of part of the economic advantage found to arise from improvement in industrial lighting conditions.

It is a happy augury of further advance in lighting practice that the National Electric Light Association and the Society for Electrical Development are undertaking to promote the application of the work of the Illuminating Engineering Society with a view to realizing in practice the advantages of good lighting which are now known to be attainable. The duplication and multiplication in important centers of population of industrial lighting exhibits patterned after that developed by the National Lamp Works of the General Electric Company bids fair to bring prompt and important results in improving industrial lighting. It is a method of attack which, if found successful, may be extended to other forms of lighting with like beneficial results. Wherever these demonstrations are given industrial managers have an opportunity to study for themselves conveniently and quickly the practical advantages attendant upon improvement in lighting. Opportunity to utilize these advantages is peculiarly favorable because incandescent lamps and central-station service stand out conspicuously among all commodities by reason of the fact that they have advanced little, if at all, in price since the pre-war period. The cost of electric lighting has been kept low and today is relatively lower than formerly.

In street lighting the combination in one lighting unit of a moderate-sized source for all-night service and of a larger source for intensive lighting during busy evening hours, as in the Saratoga installation, is one of the notable developments of the year. The installation of remote control of multiple street lamps from a central location throughout a large part of the borough of Manhattan, New York City, is another notable development not yet described in the literature of the art.

In the realm of commercial photometry the notable achievements of the year have been the more general employment of integrating spheres for the rating and tests of incandescent electric lamps in laboratories and factories and the very extensive growth in the use of the foot-candle meters for lighting inspection purposes. Another portable photometer for illumination and brightness measurements has been announced and will shortly become available.

DIRECT MEASUREMENT OF REFLECTION OF WALLS

The determination of reflection factors has been the subject of research in recent years. In 1920 the crystallization of theoretical considerations and the development of data on the value of magnesium-carbonate, which is generally accepted as a standard, were witnessed. Several reflectometers have been designed or built which appear to be capable of rendering reflection factor values of an accuracy quite as high as is required.† This subject may now be considered to be removed from the realm of uncertainty.

Potent instruments for promoting improvement in illumination are the technical and commercial bulletins of manufacturers of lamps and lighting equipment, some among which attain a high standard of engineering excellence and most of which are notable for emphasis of the broader aspects of the subject with but incidental allusions to the particular commercial applications to be promoted. Such manufacturers' literature is, of course, up to date and occupies a field of peculiar usefulness to the electrical industry. During 1920 activities along this line surpassed those of previous years.

In the industrial lighting field it may be noted as especially significant that several of the leading manufacturers of porcelain-enameled steel reflectors have joined in a co-operative quality movement, building reflectors to a common and improved design (known as R.L.M.-reflector lamp manufacturers). These manufacturers have adopted a specification for their reflectors which in respect to efficiency, candlepower, distribution characteristic and workmanship is so high that they can comply with it only by most careful design and manufacture, and they are undertaking to put out under the R.L.M. designation only such reflectors as conform to these specifications. This is a movement in the direction of promoting good lighting which should be put to the credit of these manufacturers as promising advantage to the industry.

TENDENCY TOWARD BETTER DIFFUSION

The year witnessed two wholesome tendencies in reversion from practices which developed under war-time conditions to extremes perhaps not wholly compatible with good lighting. The first of these tendencies is away from the use of a minimum number of large lighting units toward the employment of a larger number of moderate-sized units. The other is the provision of a reasonable proportion of light flux upon the ceiling in industrial establishments with consequent increase in the general and more diffused lighting component, as witnessed by the development of translucent-neck porcelain-enameled steel reflectors and by the use of larger glass reflectors.

The high cost of labor and its war-time shortage led to development of lighting units designed to remain clean as long as possible and to be easily cleaned when soiled. This feature of design is now generally recognized as a first desideratum in all classes of service in which economy receives consideration. While some designs have sacrificed seemliness and beauty to the attainment of this one object, others have sought to secure it without detriment to the appearance of the unit and have met with measurable success. Today the market offers a fairly wide choice of industrial and commercial lighting units of reasonably good appearance and easy of maintenance.

In commercial lighting more attention has been given during the past year than formerly to the employment of color for practical as well as decorative purposes. Artificial daylight of a variety of hues is coming more and more into use where color matching is done and where it is important to display objects under a light of the hue which will reveal their characteristics to best advantage or in the manner in which they are later to be exhibited. For show-window lighting color filters for modification of hue in order to attain the most pleasing or effective display of wares are now offered as standard commercial equipments.

It has long been recognized that the greatest obstacle to the improvement of home lighting is the existence of improper fixtures designed without regard to illumination requirements and installed without reference to

†See ELECTRICAL WORLD, Sept. 4, 1920, page 467.

the purpose to be achieved by the lighting. In Chicago this problem has been attacked through the adaptation of old fixtures and the addition of equipment for directing and shading light sources in order to obtain suitable and pleasing lighting effects.

The Illuminating Engineering Society's "Rules Governing the Performance of Automobile Headlights on the Road and Specifications for Laboratory Tests of Headlighting Devices for Approval by State Authorities" in original or revised form have been adopted by six states. It is said that approximately 25 per cent of the motor vehicles of the country are now subject to regulation as to headlamps in accordance with this system. The same I. E. S. system has been embodied in the proposed "uniform traffic law" of the International Traffic Officers' Association. It is understood that the National Automobile Chamber of Commerce and allied associations contemplate adoption of the system. The rules referred to are directed at regulation of automobile headlighting. A more exacting specification has been drafted by the I. E. S. committee and adopted by the Society of Automotive Engineers as a recommendation to manufacturers to govern new equipment. It would appear that this subject has been brought during the year to a stage from which the adoption of nationally applied specifications will be a logical next step. The advantage of such a development in improved headlighting conditions will be obvious.

Effect of Load Factor on Station Costs*

Steam Stations Should Be Designed for a Definite Load Factor, and Operation Above or Below This Value Results in a Loss— Coal Rate Depends Also Upon Shape of the Station Load Curve

By PETER JUNKERSFELD
Engineering Manager Stone & Webster, Boston

THAT load factor has great influence in determining central-station energy costs is not a new thought. It is important, however, to emphasize the price which may sometimes be paid in increased fixed charges or increased operating expenses on central-station equipment as a result of incorrectly predicting, through inexperience, insufficient knowledge of the conditions or other causes, the average load factor at which the equipment will operate throughout its life. An operating organization can attain favorable total station costs only within the limits fixed by those who designed the power station.

The annual load factor is an indication of the number of hours per year that the dollar of capital expenditure in a steam station can be kept at work. The expense of using this dollar is just as great when it is working 100 hours or 1,000 hours or the full 8,760 hours per year. Interest and other fixed charges have no shutdowns, no lost time. The returns are, however, in direct proportion to the number of hours per year that this dollar is kept at work, or in other words to the annual load factor. For example, if the annual load factor of a power station is increased from 30 per cent to 60 per cent the fixed charges per kilowatt-hour are cut in half.

Load factor is the ratio of the average to the maximum output during any definite period of time. It is usually based upon an average demand for, say, fifteen minutes and upon output for a day, week, month or year. It may apply to a system having many generating stations and serving many communities, or merely to one power station, or even one unit in a power station.

The anual load factor of a central-station system nearly always changes very slowly. Special effort to secure a well-diversified business, together with the new uses of electricity which are constantly arising, contributes substantially to improvement in load factor.

The ordinary factory, working a forty-four-hour week with the usual lay-off for holidays, keeps a power station busy for only one-quarter of the 8,760 hours in a year. Residence and street lighting tend to improve load factor in the summer, but are less and less of a help as the days grow shorter until they finally change from a blessing to a burden upon the plant during the months when the lighting peak overlaps the end of the factory or business day. The cost of energy is made up of two principal elements, the fixed charges and the operating and maintenance expenses. Let us see first how the fixed charges are affected by load factor. In this case we must use annual load factor because fixed charges run on year after year. Suppose that one power station has cost $100 per kilowatt.

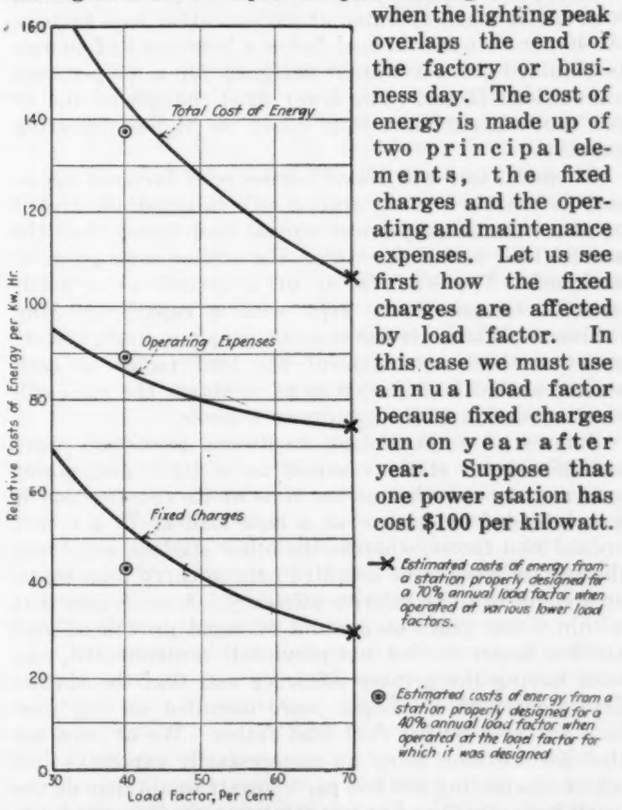


FIG. 1—RELATIVE GENERATING COSTS AT VARIOUS LOAD FACTORS

At 15 per cent per annum the fixed charge per kilowatt would be $15 each year. With an annual load factor of 30 per cent, the fixed charge per kilowatt-hour would

*Discussed before American Society of Mechanical Engineers, Dec. 10, 1920.

be 0.57 cent. If the load factor is increased to 70 per cent, we find this fixed charge per kilowatt-hour cut to 0.24 cent.

This comparison, of course, is not wholly a fair one, because a station properly designed to operate at a 70 per cent load factor would cost more to build (although less per kilowatt-hour to operate) than one of equal capacity but properly designed for a 30 per cent load factor. Its boilers would have been rated differently, turbines of different individual capacities and perhaps different efficiencies might have been selected, the condensers would have been designed more liberally, and higher efficiency equipment would have been selected wherever it would have been economical with the higher load factor. Even supposing that these features boosted the first cost $20 per kilowatt, we would still save probably one-tenth of a cent per kilowatt-hour in fixed charges and operating expenses in comparison with an attempt to impose a 70 per cent load factor on a plant properly designed for 30 per cent.

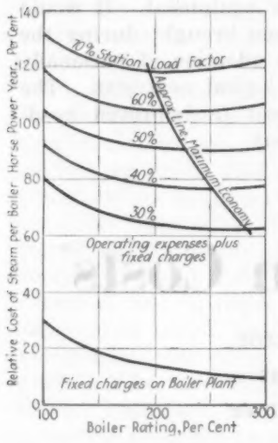


FIG. 2—BOILER RATING AS AFFECTED BY ANNUAL LOAD FACTOR

The curves in Fig. 1 show the relative costs of energy from a power station designed for a 70 per cent annual load factor when operated at various other load factors. At 40 per cent annual load factor a lower cost of energy is obtained from a station designed for a 40 per cent annual load factor. The lower fixed charges on the 40 per cent station more than offset its higher operating expenses.

Financial loss will result whenever it becomes necessary to operate a power station at a substantially higher or at a substantially lower annual load factor than the annual load factor for which the station was properly designed. The load factor of a system as a whole usually changes slowly even with a rapidly growing business. Where several stations supply a single system under a single management the load factor at each station should be adjusted so as to obtain the most efficient operation of the system as a whole.

Suppose that the station mentioned previously were one of several stations supplying a light and power system. Assume that at the time of its construction it was intended to operate on a base load at 70 per cent annual load factor, whereas the other stations supplying the system were to be operated only to carry peak loads, on account of their inferior efficiency. Assume also that within a few years on account of rapid growth of load another larger station, not previously contemplated, was built having the greater efficiency and that the station first mentioned no longer were operated on the base load but at a 30 per cent load factor. We at once see that we are then using an unnecessarily expensive tool where one costing $20 less per kilowatt would then do the work just as well and at less total cost per kilowatt-hour.

Similar financial losses may occur in a single power station supplying a rapidly growing load. When a new unit is installed in a power station it is important to know approximately how soon another will be required. Each succeeding unit is frequently larger than the preceding ones, up to the practical limit of size available for the particular purpose. The increased size is usually accompanied by increased efficiency. The units of highest efficiency carry the bulk of the load. The extra price paid for extra efficiency in a power-station unit sometimes proves uneconomical owing to another larger unit being installed earlier than anticipated.

The cost of an error of judgment or the extra expense due to an unexpected change in the annual load factor at which a station or unit is operated may therefore be considerable.

LOAD FACTOR INFLUENCES CENTRAL-STATION LOCATION

The location of a central station relative to its raw-material supply and relative to the point of delivery of its finished product should be influenced greatly by load factor.

In the selection of a site condensing water usually receives first consideration. Transporting it adds greatly to the station's fixed charges, while cooling it artificially causes inefficient operation. A very low annual load factor likely to prevail over a long period of years sometimes justifies artificial cooling of condensing water if the station may thereby be located near the load with a minimum investment in transmission lines or cable. With a larger annual load factor the additional operating expense due to cooling the condensing water might be so large as entirely to outweigh the fixed charge on the transmission line so that the plant would be located where condensing water is available. In weighing the relative costs the operating expense at either location must be added to the fixed charge before the more advantageous site can be determined.

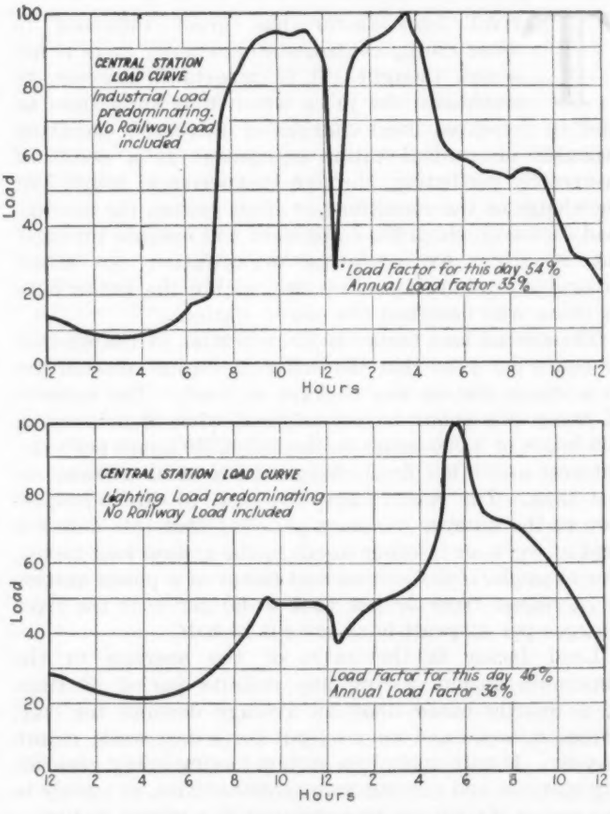


FIG. 3—SHAPE OF DAILY LOAD CURVE MAY HAVE LARGE EFFECT UPON OPERATING EXPENSE

Load factor determines the quantity of fuel consumed by a power station and has considerable influence upon the efficiency with which it is burned. Starting, stopping and standing by, as well as operating equipment only partly loaded, as is required at low daily factors, inevitably result in a high coal rate. It is the engineer's task carefully to weigh cost against efficiency and load factor so as to select equipment properly.

One of his problems, if the station be a new one, is to determine the boiler pressure. High efficiencies can be obtained with high boiler pressure. Construction cost, on the other hand, increases rapidly with increases in pressure. The economical pressure should usually be determined by the extent of the use of the equipment; that is, by the annual load factor.

An arbitrary assumption of steam pressure or an arbitrary selection of certain principal items of equipment may so definitely restrict the design that the full financial benefits of a consideration of load factor in the later selection of additional equipment may not be realized. The most far-reaching power-station engineering is done during the conception of the project, and it is at this time, when fundamental decisions are being made which will either help or hinder the engineering, construction and operation of the station, that load factor should have the greatest consideration. This means not only the immediate load factors but also the load factors that could reasonably be expected during the probable life of the equipment.

Reference has been previously made to the differences in boiler rating for which central-station boiler plants would be designed for operation at different annual load factors. This depends upon the cost of the boilers and combustion equipment, their efficiencies at various loads, the cost of labor and maintenance at various loads and the fuel required for banking and starting. Fig. 2 shows for a particular case, selected as an example, the effect of load factor on the most economical rating at which boilers should be operated to carry the station peak load. Note the manner in which the rating increases as the load factor diminishes.

The rating is only one of a number of boiler-plant problems which must be solved on the basis of load factor. The type and design of the boiler, the length of its tubes, the number of rows of tubes wide and the number of rows high, the combustion equipment, the location of the bridge wall and the baffles, and the size and shape of the furnace, should all be determined by reference to the total load factor on the station as well as the anticipated load factor on the individual boilers. The use of economizers even in large stations cannot be justified at very low load factors.

The economic selection of turbo-generator units may be made upon the basis of size, speed and other factors. The speed influences both the cost and the efficiency of the unit, and is very important in relation to the average annual load factor at which the machine will operate over a period of years.

Surface condensers also should be selected largely from the point of view of annual load factor. A high load factor anticipated for a unit for a long period of time would justify a condenser of large surface so as to obtain a high efficiency in operation.

The foregoing does not attempt to mention the many power-station appurtenances contributing to higher efficiency which should be omitted from the station designed to operate at low annual load factor, but which might be justified if the station annual load factor were higher. On the other hand, it should not be overlooked that there are some instances in which it is more economical to buy more expensive equipment for low load-factor conditions than for higher load-factor conditions.

Low Load Factor Occasionally Calls for Expensive Equipment

An example comes to mind in which it was necessary to transmit power through step-up transformers at about a 30 per cent annual load factor. The load curve was typical of a factory load in which the maximum amount

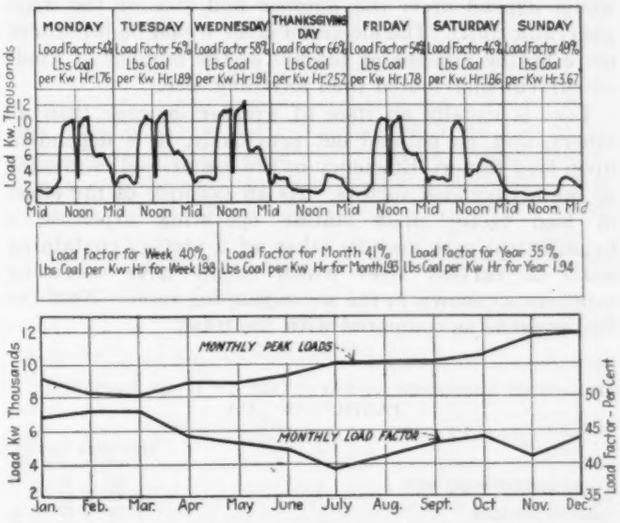


FIG. 4—COAL RATE DEPENDS BOTH UPON LOAD FACTOR AND SHAPE OF LOAD CURVE

The effect of designing a station for too high load factor is shown.

of power was supplied more or less continuously for about eight hours of the working day with a much smaller amount of power for the remaining sixteen hours. When it came to the purchase of the transformers, all of those offered had the same full-load efficiency. The transformers of the lowest bidder, however, had the highest no-load losses. The partial-load conditions to be met were discussed, requirements more clearly stated and certain changes in design suggested.

New bids were received, and the transformers finally selected were designed for the particular conditions, but at an advanced price. The increase was due to the additional cost of the higher-grade materials which were selected for use in the transformer construction and the changes in design which were made on account of the particular load conditions. The use of these materials and their additional cost would not have been justified if the transformers had been operated at a higher load factor as the full-load efficiency was not increased by the changes which were made. The additional cost of the transformers was saved in about two years because of the lower twenty-four-hour losses.

The engineers who design a power station fix the upper limit of its operating efficiency by the selection and arrangement of equipment. If this is properly done for the particular load and load factor, the total cost of power from that station, including the fixed charges upon the investment, will be a minimum if the station is properly operated and maintained. If the selection arrangement is not made wisely, the station thereafter will be handicapped either by excessive fixed charges or excessive operating expenses.

The influence of a change of load factor on operating

expenses has been briefly referred to heretofore, but it may be of some interest to point out its effects.

The expense of superintendence and station administration is more or less fixed for a given size of station so that a change of load factor would not influence it in total amount. Boiler labor may be considered as composed of two parts, one of which depends upon the capacity of the station alone and the other of which, for a station of given capacity, would vary with the daily load factor at the station. Mechanical labor would be influenced by daily load factor to a less degree, but would depend upon the number and size of the main generator units. The electrical labor would be influenced more by the number of feeders or the number of kinds of current distributed than anything else.

Fuel is usually an item of greater expense than all others, and, as pointed out previously, it is dependent upon load factor. Efficiency in the use of fuel is greater at the higher load factors. As an example of the effect of load factor upon station operating expenses, a hypothetical case may be taken of a station containing units of various sizes which might have operating expenses as shown in the accompanying table. Note the fuel expense as compared with the total.

OPERATING EXPENSES AS AFFECTED BY LOAD FACTOR IN A PARTICULAR CASE

	Operating Expenses Cents per Kw.-Hr.		
Annual load factor, per cent	30	50	70
Fuel	0.91	0.85	0.71
Labor for operation	0.10	0.07	0.06
Maintenance, material and labor	0.08	0.05	0.04
Miscellaneous, material and labor	0.04	0.03	0.03
Total	1.13	1.00	0.84

Load factor alone does not by any means determine the amount of fuel which a central station of a given size should consume. The shape of the daily load curve is of almost equal importance in its effect upon the efficiency with which the fuel is burned. The shape of the load curve is in turn dependent upon the character of the business served by the central station. This is illustrated by the two examples of central-station load curves given in Fig. 3. In both instances the lighting peak overlaps the day load, but on account of the predominance of factory load in the business on one of these stations an exceptionally favorable shape of load curve is obtained as well as a relatively high load factor for the day.

SHAPE OF LOAD CURVE IMPORTANT

It is interesting to note, however, that the load factor for the year is virtually the same in these two cases. This is due to the effect of the extremely low loads which obtain on Sundays and holidays. For these two conditions, illustrated by Fig. 3, having practically the same annual load factor, the better annual coal rate would be obtained with the one having the more favorable shape of load curve—that is, with the one in which the factory load predominates.

Fig. 4 shows how the load and load factor vary from day to day and month to month for a business in which factory load predominates. The beneficial effect of high load factor on Thanksgiving Day, for example, is much more than offset by the relatively small load on the station on that day. Note how the load factor for the week and for the month are practically the same. The load factor for the year is somewhat lower, owing to the variation in maximum demand throughout the various seasons. In general, the better coal rates are obtained with the higher load factors, although this is greatly influenced by peak load, quality of fuel and skill in operation, all of which are interesting subjects but beyond the scope of this discussion.

Customer Ownership Exceeds $100,000,000

Power Securities Now Distributed Among 150,000 Subscribers—Provides from 25 per Cent to 100 per Cent of Companies' Financial Needs

FINANCING electric utilities through the sale of securities locally to customers, employees and resident citizens within the past three years has developed into an important phase in the management of many central-station companies. To show the extent of this type of financing, what methods were used to market securities, how nearly the plan meets current financial requirements, and to estimate its future possibilities, the ELECTRICAL WORLD has made a survey among those companies which have been actively engaged in customer-ownership sales. Complete data received from forty-five companies show that the total par value of stocks, bonds and notes sold by them since they first started selling securities to customers is $50,294,450, distributed among 75,941 subscribers. Further information from four large holding companies which could not segregate the sales made by each of their controlled companies and from a number of other individual companies shows that the total sale of securities to customers has been in excess of $100,000,000, distributed to over 150,000 individuals.

Since Jan. 1, 1920, there has been $16,116,870 of stocks, bonds and notes sold, which is 31.3 per cent, or almost one-third, of all sales to date. Of the forty-five companies reporting, sixteen sold securities to customers for the first time in 1920, ten in 1919, six in 1918, six in 1917, two in 1916, two in 1915, two gave no date, and one company initiated its customer-ownership campaign in 1908. The majority of the companies, twenty-six, have instituted the plan within the last two years, indicating that this kind of financing is now being adopted rapidly. Statements from managers of many companies show that while they are not at this time conducting such a sale, they are laying plans for next year.

PREFERRED STOCK MOST GENERALLY SOLD

Of the combined sales by all companies, $3,974,250, not quite 8 per cent of the total, were bonds or notes. The remainder of the securities sold, with two exceptions, were in the form of preferred stock, which is naturally best adapted to the purpose, providing as it does a sound investment without maturity and making the holder a partner in the business. Thirty-eight companies sell this kind of security. Five sell notes, two sell bonds, one sells capital stock, and one common stock. Practically all companies offer customers the privilege of paying for the stock on an easy-payment plan over a period of eighteen months to two years. Sales are usually limited to five shares to a customer when installment payments are to be made.

The total of $50,294,450, including all stocks, bonds and notes, was distributed among 75,941 subscribers,

showing an average ownership per individual of $660. This figure covers sales for the entire period and is based upon the par value of the securities, which in most cases have been sold at a discount of from two to fifteen points. Therefore the actual cash investment per subscriber is close to $600. Subscription per customer subscriber of those companies which have operated only this year varies over a wide range and shows an average par value investment of $469. This should be modified somewhat owing to high sales per customer by two companies. The par value investment per subscriber in a customer-ownership program operated this year for the first time is approximately $350. However, this depends upon the locality and sales methods pursued. As a rule where a special bond department only conducts the sales the amount sold per customer is high, while the use of all employees as salesmen secures a much wider distribution. The ideal arrangement seems to be the combination of a security department working in conjunction with the employees. In this manner the territory is thoroughly covered.

Employees were used exclusively as stock salesmen by twenty-nine companies, bond department and special salesmen were used by seven companies, securities departments supplemented by all employees were used by seven companies, and two companies sold their securities over the counter. In nearly all cases commissions were paid to employees for stock sold, and during special campaigns bonuses were offered. Employees have been considerable purchasers of stock. Their individual subscriptions and the percentage of stock owned by them are small. This, however, is held by some to be desirable as it means that there is a better and wider distribution of the securities.

SALES METHODS

In thirty-six companies the sale of stock is carried on continuously, while six companies reported the use of campaign methods over a given period. All companies emphasized the importance of a liberal advertising program in the newspapers backed up by personal efforts of the salesmen and employees. Continuous selling is favored as being the most effective method and best from a public policy standpoint.

ELECTRIC UTILITY SECURITIES SOLD TO CUSTOMERS, EMPLOYEES AND RESIDENT CITIZENS

Company	Date Started	Kind of Security	Interest Rate, Per Cent	Total Sales to Date (No.)	Amount (Par Value)	No. Subscribers	Average per Subscriber	Amount of Sales in 1920 (Par Value)	Method of Sales	Per Cent of Securities Held by Employees	Per Cent of Current Financial Requirements
Arkansas Valley Ry., Light & P. Co.	1917	Preferred stock	7	11,685	$1,168,500	1,650	$708	$488,400	Employees	1.1	Variable
Binghamton Light, Heat & Pr. Co.	1920	Cum. part. prfd. Stock	7	1,575	157,500	666	236	157,500	Employees	3.0	Provides equity financing
Central Connecticut Pr. & Lt. Co.	1919	Cum. prfd. stock	6	400	40,000	120	283	22,950	Employees	....	Well in future
Central Illinois Public Service Co.	1919	Preferred stock	..	6,000	600,000	1,800	333	.....	Employees	5.0	.....
Central Illinois Light Co.	1919	Preferred stock	6	3,177	317,700	605	524	.....	Employees	....	Small
Central Maine Power Co.	1908	Preferred stock	6	31,221	3,122,100	4,000	781	1,100,000	Stock dept. and employees	....	All
Charlottesville & Albemarle Ry. Co.	1915	Preferred stock	7	1,000	100,000	105	952	.....	Employees	....	Partial
Commonwealth Edison Co.	1919	Capital stock	8	40,000	4,000,000	3,500	1,140	.....	Investment dept. and employees	....	Partial
Connecticut Power Co.	1919	Two-year notes	8	.....	200,000	281	712	.....	Employees	....	About 30
Consumers Power Co.	1920	Preferred stock	7	5,670	567,000	1,435	395	567,000	Employees	20.0	Small
Dayton Power & Light Co.	1919	Preferred stock	6	2,240	290,750	219	1,325	.....	Employees	68.0	20
Denver Gas & Electric Co.	1916	Preferred stock	6	12,000	1,200,000	.....	.....	.....	Employees	....	.....
Edison Electric Tel. Co., Brockton, Mass.	1918	Two-year notes	8	.....	251,900	353	713	.....	Employees	1.0	About 30
Greenville Elec. Lt. & Power Co.	1920	Preferred stock	7	1,500	150,000	.....	.....	150,000	Over counter	....	.....
Louisville Gas & Electric Co.	1920	Preferred stock	7	8,500	850,000	1,525	557	614,000	Investment dept.	3.6	Variable
Lockport Light, Heat & Power Co.	1920	Preferred stock	8	1,802	180,200	378	478	180,200	Employees	Small	All
Mahoning & Shenango Ry. & Lt. Co.	1919	Preferred stock	7	8,000	800,000	1,300	769	.....	Employees	....	Partial
Metropolitan Edison Co.	1920	Cum. part pfd. stk.	7	5,965	596,500	2,514	236	596,500	Employees	5.0	Provides equity financing
Mexico Power Co.	1920	Preferred stock	7	1,000	100,000	.....	.....	100,000	Over counter	....	All
Middle West Utilities Co.	1919	Preferred stock	7	22,600	2,260,000	10,000	226	.....	Employees	....	Partial
Minnesota Utilities Co.	1917	Bonds and preferred stock	5 7	1,523	775,000	190	4,079	187,300	Employees and stock salesmen	3.0	Full
Mountain States Power Co.	1920	Ten-year notes	8	.....	72,650	200	363	72,650	Employees	3.0	Partial
Narragansett Electric Lt. Co.	1917	Preferred stock	8	13,335	666,750	3,000	222	416,750	Employees	....	Variable
New Jersey Power & Light Co.	1920	Preferred stock	7	800	80,000	331	242	80,000	Employees	0.6	Provides equity financing
North American Light & Power Co.	1920	Preferred stock	7	.....	45,000	.....	.....	45,000	Employees	....	.....
Northern Iowa Gas & Electric Co.	1920	Preferred stock	7	750	75,000	85	882	75,000	Employees	....	.....
Northern States Power Co.	1915	Preferred stock	7	99,212	9,921,000	14,500	684	3,411,700	Securities dept.	1.3	Variable, as high as 75
Ohio Service Co.	1918	Preferred stock	6	2,998	299,800	298	1,000	145,600	Employees	2.6	One-half
Oklahoma Gas & Electric Co.	1917	Preferred stock	7	6,024	602,400	830	725	259,600	Securities dept.	6.6	Variable
Otter Tail Power Co.	....	Bonds	6	.....	927,000	400	2,320	80,000	Bond dept.	....	About 75
	....	Stock	7	3,210	321,000	300	1,070	.....			
Ottumwa Railway & Light Co.	1917	Preferred stock	7	600	60,000	200	300	.....	Special salesmen	....	Variable
Public Service Co. of No. Illinois.	....	Preferred stock	6	23,900	2,390,000	10,500	227	2,390,000	Investment dept. and employees	....	Partial
Puget Sound Power & Light Co.	1920	Five-year notes	8	.....	1,000,000	2,000	500	1,000,000	Employees	40.0	Partial
Rochester Railway & Light Co.	1918	Preferred stock	7	17,061	1,706,100	2,893	609	203,800	Employees	8.6	50 to nearly all
Rutland Railway, Light & Power Co.	1920	Cum. Prfd. stock	7	458	45,800	193	237	45,800	Employees	1.1	Provides equity financing
San Diego Con. Gas & Electric Co.	1916	Preferred stock	7	19,454	1,945,400	745	2,610	500,000	Bond dept.	8.0	All
San Joaquin Light & Power Co.	1920	Preferred stock	7	15,000	1,500,000	1,400	1,070	1,500,000	Securities dept. and employees	7.5	About 25
Southern California Edison Co.	1917	Common stock	7	86,334	8,633,400	5,100	1,690	884,920	Bond dept. and employees	37.0	About 25
Southern Illinois Light & Power Co.	1920	Preferred stock	6	950	95,000	.....	.....	95,000	Employees	....	About 15 in future
Twin State Gas & Electric Co.	1919	Prior-lien stock	7	2,500	250,000	900	278	170,000	Stock dept. and employees	5.0	Variable
United Light & Railways Co.	1920	Preferred stock	7	625	62,500	.....	.....	62,500	Employees	....	.....
Wilkes-Barre Co.	1919	Preferred stock	7	6,748	337,400	650	518	109,700	Employees	Small	Full
Western Illinois Utilities Co.	1918	Preferred stock	6	150	15,000	50	300	.....	Employees	....	Small
Western States Gas & Electric Co., Eureka, Cal.	1918	Preferred stock	7	5,161	516,100	525	982	405,000	Special salesmen	1.0	Variable
Western States Gas & Electric Co., Stockton, Cal.	1918	Ten-year notes	6	.....	900,000	200	4,500	.....	Company officials	....	All that year
Totals and average				470,128	$50,294,450	75,941	$660	$16,116,870			

All reports indicated that the sale of securities has become a permanent policy. Some companies which are not now offering stock to customers explained that it is because they have sold the entire available issue and must now turn down applications for stock. No company has reported the failure of a customer-ownership program. and all favor it as a valuable means of improving public relations.

PROPORTION OF REQUIREMENTS

The extent to which the sale of these securities meets current financial requirements varies with each company. Some state that it is small, while in several cases all new money is obtained in this manner. A particularly notable instance is that of the Central Maine Power Company, which for some time has raised all new capital by the sale of its 7 per cent preferred stock in the territory served. Other companies have financed all necessary new construction during the past eighteen months by this method.

PROVIDES EQUITY FINANCING

One group of companies indicates that its sale of preferred stock provides an ideal means for equity financing and that it materially strengthens the position of the companies' other securities. The majority report that their object is to raise about 25 per cent of new capital by the sale of securities to customers. The viewpoint of a prominent investment banker is interesting. In his opinion customer ownership has brought the utilities through one of the most difficult financial situations in their history. It is the cheapest and best way of obtaining new capital. It facilitates long-term financing, and the electric utilities in the future should be able to meet from 25 per cent to 50 per cent of their financial requirements by the distribution of preferred stock to customers.

In making an estimate of the amount of stock that can be sold to customers, based on what has been done since 1916, due allowance must be made for the fact that during the war all sales of securities were subordinated to the Liberty loan campaigns. As a consequence customer-ownership programs suffered interruptions and a great deal of investment money was placed in Liberty bonds. However, the Liberty loan campaigns have been extremely valuable in creating millions of small investors who are now good prospective customer stockholders of the electric utilities.

CUSTOMER OWNERSHIP INCREASING

Something over $100,000,000 of the electric light and power companies' securities, principally in preferred stocks, have been distributed among 150,000 customers —an average par value investment per subscriber of $666. Companies have been successful in several instances in doing all their financing by this method, which shows its possibilities. Thus far there has been no failure of the plan reported. Comparatively, it is as cheap as or cheaper than selling securities through the customary channels and naturally much better for the standing of the company in the community. The number of companies so selling securities is increasing, and those companies already engaged are committed to it as a permanent policy. Therefore it is safe to say that customer ownership is a fixed principle with electric light and power companies and that, properly directed, it can be made to provide from 25 per cent of their financial requirements up to the entire amount.

Recommendations for Niagara Treaty Revision

Additional Diversion of 20,000 Sec.Ft. Suggested, Making a Total of 80,000 Sec.Ft.—Momentary Diversion in Excess of Limit to Be Allowable

BY COL. J. G. WARREN, U. S. A.

INASMUCH as any large power development is dependent on the revision of the treaty with Great Britain proclaimed May 13, 1910, a careful study has been made by the War Department regarding changes which will be necessary in the treaty to permit additional diversion of water. As a result of this study the following suggestions were made:

1. That the wording of the treaty be altered to extend the jurisdiction of the International Joint Commission to include diversions from tributaries of boundary waters, except in the case of diversions from a tributary which are returned to the same tributary.

2. That the diversion of water from Niagara River below the Falls be specifically limited in the same manner as the diversion from the Niagara River above the Falls.

3. That the treaty provide for the construction and maintenance of remedial works of the nature outlined, such works to be built under the supervision of the International Joint Commission or of some other international body created for the purpose, the remedial works to be so designed and constructed that the scenic beauty of the Falls will be restored and preserved when 80,000 cu.ft. of water per second is diverted from the Niagara River above the Falls, the expense of constructing and maintaining said works to be borne equally by the high contracting parties.

4. That the limits of diversion from the Niagara River above the Falls which the high contracting parties may permit within their respective jurisdiction be raised from 20,000 cu.ft. per second on the United States side to 40,000 cu.ft. of water per second, and from 36,000 cu.ft. of water per second on the Canadian side to 40,000 cu.ft. of water per second.

5. That 20,000 cu.ft. per second of the water so diverted upon each side of the river shall be returned to the Niagara River at some point or points upstream from turning point No. 134 of the international boundary line (just above M. C. R.R. bridge), and that if any part of the remaining diversion be returned to the Niagara River at any point, an equal or smaller amount may be again diverted from any point further down stream.

6. That the limits given above be stipulated to apply to the amount actually diverted at any instant, and that accordingly the words "in the aggregate" and "daily" be stricken out of Article V of the present treaty wherever they occur; that it be recognized that small, brief, accidental violations of the provisions of a diversion permit must be allowed if the holder of the permit is to obtain the full value thereof, and that therefore such violations shall be permitted under such regulations as the International Joint Commission shall provide.

7. That five years after the completion of the remedial works the International Joint Commission, or some other body constituted for the purpose, shall inform the high contracting parties whether or not, in its opinion, further diversions of water from the Niagara River for power development can be made, either continuously or intermittently, without serious injury to the scenic beauty of the Falls and Rapids, the integrity of the river as a boundary stream, or appreciable lowering of lake levels; that, if this opinion be favorable to the further diversion of water, the commission or body shall indicate the amount of further diversions which may properly be allowed and the conditions by which permits should be limited.

[Several methods of utilizing additional diversions were discussed in the Aug. 14, 1920, issue of the ELECTRICAL WORLD.—EDITOR.]

Determining Iron Loss of Sheet Samples

Testing of Sample Laminations Necessary to Secure a Uniform Manufactured Product — A Good Method for Industrial and Central Station Men and an Accurate One Where Laboratory Facilities Permit

By THOMAS SPOONER
Research Laboratory, Westinghouse Electric & Manufacturing Company

IN SPITE of the many improvements effected in recent years in the manufacture of electrical steel, the mills are still unable to make a product which is sufficiently uniform in magnetic quality. This is due to the very large number of variable factors which enter into the manufacture of steel. On the other hand electrical apparatus is built under specifications which require laminations of uniform quality, and as a consequence the electrical manufacturer must either have rigid magnetic specifications for the quality of his sheet material, or else must accept whatever the manufacturer supplies, test it himself and divide it into grades according to the quality in order that he may use it to the best advantage. In either case careful testing is required in connection with the purchase of sheet steel. Furthermore, on account of the large amount of sheet iron used in rebuilding and repairing electrical apparatus in industrial plants and central stations a substitution method is offered here which is sufficiently

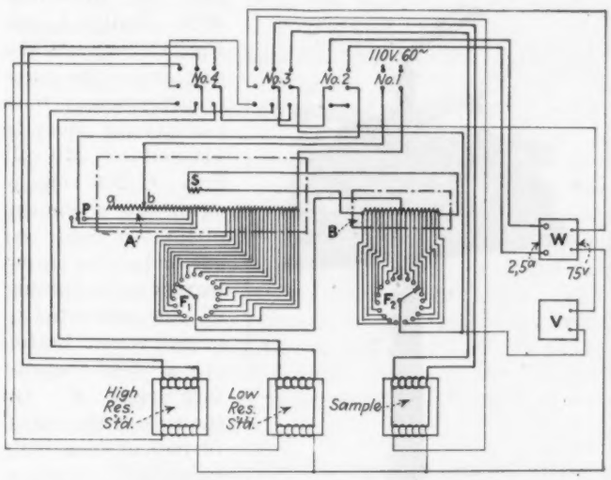


FIG. 1—DETAILED ARRANGEMENT OF SUBSTITUTION METHOD

accurate for the purpose of making tests in such plants. An accurate method is also described for the use of the manufacturer of electrical apparatus who uses large quantities of sheet iron and who has the necessary laboratory equipment for very accurate testing. The usual magnetic test specification covers only two properties, namely, total iron loss (hysteresis and eddy current losses) and permeability. In this article only the former will be considered.

In the following paragraphs various methods of testing commercial sheet steel for iron loss are described, including a substitution method for obtaining sine wave losses which may be used with any commercial 60-cycle voltage supply and requires no special apparatus except two simple regulating auto-transformers. Test results are given showing the accuracy of the apparatus, covering a period of more than three years, during which time no adjustment of the apparatus and no calibration of the meters have been made. The accuracy is quite satisfactory for commercial purposes.

SPECIFICATIONS OF THE A. S. T. M.

Test Specifications.—The most common apparatus for testing iron losses is that due to J. Epstein. It has been adopted as standard both in this country and several foreign countries. The material to be tested is sheared into long narrow strips divided into four equal bundles which are arranged in a hollow square with a primary and secondary winding surrounding each bundle (see Fig. 3). The sample is clamped in position by a single movement of the compression handle. The four primary coils are connected in series and to an alternating source of supply through the current coil of a wattmeter. The secondary coils are also connected in series and to the shunt circuit of the wattmeter and to a voltmeter. The voltmeter gives a measure of the induction in the sample, and with suitable corrections the wattmeter gives the iron loss. The American Society for Testing Materials some years ago adopted this method as standard (see A. S. T. M. "Triennial Standards" for 1918, page 268). According to its specification the standard core loss is "the total power in watts consumed in each kilogram of material at a temperature of 25 deg. C., when subjected to a harmonically varying induction having a maximum of 10,000 gausses and a frequency of 60 cycles per second." The samples themselves consist of 10 kg. of strips 50 cm. long by 2 cm. wide. The primary and secondary windings each consist of 600 turns. The proper voltage to give 10,000 gausses is calculated as follows:

$$E = \frac{4fNnBM}{4lD10^8}$$

in which

f = form factor of primary emf. = 1.11 for sine wave,
N = number of secondary turns = 600,
n = number of cycles per second = 60,
B = maximum induction = 10,000,
M = total mass in grams = 10,000,
l = length of strips in centimeters = 50,
D = specific gravity = 7.5 for high-resistance steel and 7.7 for low-resistance steel,
E = 106.6 volts for high-resistance steel and 103.8 volts for low-resistance steel, both for sine voltage.

For further details see the A. S. T. M. specification.

AN ACCURATE LABORATORY METHOD

If it were not for the fact that the wave form materially affects the iron losses, this method of testing would be very simple. For a discussion of the effect of wave form on iron loss see "Dependence of Magnetic Hysteresis Upon Wave Form," by M. G. Lloyd, *Bulletin* Bureau of Standards, Vol. 5, page 381.

In order to obtain sine-wave conditions a number of arrangements have been used. For research work and for standardizing secondary samples the Westinghouse Research Laboratory uses the following set-up (see Fig. 2): The direct-current motor *ShM* drives a three-phase alternating-current generator *G* and a harmonic booster *HB*, all three machines being on the same shaft. The booster *HB* generates a third harmonic and is in series with one phase of the generator *G*. This third harmonic may be introduced into the alternating-current circuit with any phase angle by rotating the field of the booster. Connected to the booster and generator is the auto-transformer *T*, which supplies the Epstein apparatus *E* through the wattmeter *W*. The secondary of the Epstein apparatus is connected to an alternating-

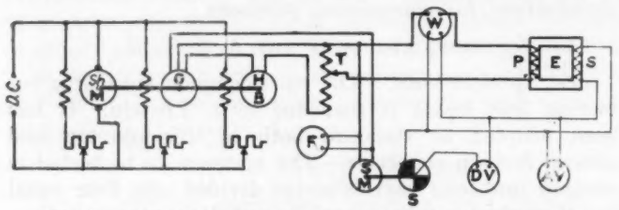


FIG. 2—SIMPLIFIED CIRCUIT FOR ACCURATE LABORATORY METHOD OF CORE-LOSS TEST

current voltmeter *AV*, a direct-current voltmeter *DV*, and to the shunt circuit of the wattmeter. The direct-current voltmeter is connected in series with a suppressor *S* driven by a synchronous motor *SM*. This synchronous motor, together with a frequency meter *F*, is connected to another phase of the generator.

The operation is as follows: The frequency is adjusted to 60 cycles by varying the field of the shunt motor. The voltage is adjusted by varying the field of the generator, and the form factor is adjusted by varying the field of the booster. The direct-current voltmeter *DV* is a two-to-one double-scale instrument. It is connected to the low scale and read on high, since every half wave is suppressed. When the form factor is correct the ratio of *AV* and *DV* will be 1.11, provided that the suppressor is adjusted in phase so that *DV* reads a maximum. The direct-current voltmeter is then opened and *AV* adjusted to the voltage value necessary to give a maximum induction in the sample of $B = 10{,}000$ gausses. The wattmeter is then read. The instrument losses in the shunt circuit of the wattmeter and the alternating-current voltmeter are subtracted, the difference divided by the weight of the sample in kilograms, and the result is the loss in watts per kilogram for the sample.

The above procedure requires considerable rather expensive apparatus and is somewhat complicated. As a consequence several alternative arrangements have been devised to simplify the procedure for commercial testing. If the generator is of sufficient size and is carefully designed so as to give a sine wave of voltage, the harmonic booster and form factor apparatus may be omitted for tests at $B = 10{,}000$ gausses. If results are required at higher inductions, however, the exciting current of the sample will distort the voltage wave due to the resistance and reactance in the primary circuit, thus giving erroneous results.

For the greatest simplicity it is desired to have an apparatus which can be operated from a commercial alternating-current circuit. Several methods for doing this have been devised. One of the best known is to have a standard sample the losses of which have been carefully measured on a sine-wave supply. The standard sample is then placed in an Epstein apparatus, the unknown sample in a second Epstein apparatus, and the primary windings connected in parallel to an alternating-current supply through the current windings of a differential wattmeter. The secondary Epstein coils are connected to the respective shunt windings of the wattmeter. By varying the resistance in the shunt windings so that the wattmeter reads zero, the loss in the unknown sample may be determined, since the losses in the two samples would be inversely proportional to the resistances in the wattmeter shunt circuits. This method has the advantage that the test results are nearly independent, over a considerable range, of the frequency, voltage and form factor of the supply circuit. It has the disadvantage, however, that a special and expensive wattmeter is required as no such instrument suitable for this work is on the market, at least in this country. Moreover, the two wattmeter elements must be identical or else a suitable correction factor applied.

SUBSTITUTION METHOD WITH SIMPLE APPARATUS

In order to obviate the necessity of using a special wattmeter, the following arrangement was devised some years ago for testing a sample by comparison with a standard (the loss of which is known). The only special apparatus required are two auto-transformers with a number of regulating taps for fine adjustment of voltage. If an alternating-current generator of any reasonable wave form the voltage of which may be varied is available, even these may be dispensed with. Switch 1 (see Fig. 1) connects the primary of the auto-transformer *A* to a commercial 60-cycle 110-volt or 220-volt line. If 220 volts is used, tap *a* instead of tap *b* is used. At one end of the transformer are a number of taps connected to every other button of a field-rheostat face plate F_1. On the core of the transformer *A* is a little secondary winding of three turns which is connected to the terminals of a second auto-transformer *B*.

FIG. 3—ASSEMBLY OF EPSTEIN APPARATUS

Taps from this second transformer are connected to a second face plate F_2. Specifications for the transformer windings are as follows:

Transformer A.—Total primary turns, 440; taps at 220, 315, 325, 335, also 420, 421 to 440; $E = 220$ volts; $I = 30$ amp.; frequency $= 60$ cycles; secondary turns, three.

Transformer B.—Total turns, 20; taps at each turn.

Three Epstein sets are provided, one for the sample to be tested, one for a high-resistance standard and one for a low-resistance standard. The standard samples are placed in their coils, wedged permanently in position and impregnated. No clamping device is supplied for the standard samples. These standard samples are

then calibrated for loss on a sine-wave supply as explained above. The wattmeter is a commercial compensated low-power-factor instrument having a current range of 0 to 2.5 and 0 to 5 and a voltage range of 0 to 75 and 0 to 150. Any alternating-current voltmeter with suitable range may be used.

The operating of the apparatus is as follows: Switch 1 is closed, thus energizing the transformers. Switches 2 and 3 are closed down. Switch 2 is used simply to prevent an accident happening to the wattmeter in case there should be a short circuit in the apparatus or in case switch 3 should be closed on the Epstein apparatus without a sample in the coils. Switch 4 is then closed, either up or down, depending on whether high-resistance or low-resistance material is being tested. Switch 2 is then thrown up and the rheostat contacts F_1 and F_2 are adjusted until the wattmeter reads the known loss of the standard sample. It will be noted that F_1 gives coarse adjustment and F_2 fine. If the correct voltage cannot be obtained, owing to a large difference in the supply from normal, a still further range may be obtained by changing terminal P to one of the other taps. When the wattmeter reads the correct value the voltmeter reading is noted. Switch 3 is then thrown up, voltmeter Vm adjusted to the same reading as before and the wattmeter read. This gives the loss of the unknown sample. It should be noted that the voltmeter is connected to the primary side of the Epstein apparatus and that the only energy used from the secondary circuit is that necessary to supply the wattmeter shunt circuit. This is automatically subtracted from the wattmeter readings since the wattmeter is compensated.

In order to save expense a 5-kg. sample instead of a 10-kg. sample is usually used for commercial work. The wattmeter has two scales, one for the 75-volt connection and one for the 150-volt. If the sample has a loss of, say, 3 watts per kilogram, the total loss will be 15 watts. This will be read directly on the low scale. However, if the reading is taken on the high scale and the decimal point shifted, the reading will be given directly in watts per kilogram. It will be noted that the transformer connection used gives a little more than 50 volts for the primary of the Epstein apparatus instead of a little more than 100 as called for by the A. S. T. M. specifications. This is due to the fact that the half-weight sample is used and so the applied voltage must be one-half.

Possible Source of Slight Errors

It will be noted that changes in the supply voltage will not introduce errors, since the voltmeter is maintained at the proper value by the contacts F_1 and F_2. Variations in frequency will not introduce errors unless they occur between the time the standard sample is checked and the unknown is tested. A 1 per cent change in the frequency under these conditions will produce an error of about 0.6 per cent in the iron-loss reading. However, the frequency of large commercial power plants is usually maintained fairly constant. If frequency changes are considerable, the errors may be reduced by frequently checking against the standard sample, or by using an iron-loss voltmeter for Vm.

The value of the form factor of the supply circuit is immaterial, provided that it does not change between the time of checking the standard sample and testing the unknown. An appreciable change would occur only if the supply generator were changed or there were large changes in the reactive load in the near neighborhood. If such conditions do exist, the remedy is the same as for changes of frequency.

It may be argued, since the voltmeter is on the primary side of the Epstein apparatus, that, as different samples are introduced for test, the variations in permeability, reluctance of joints, etc., will change the IR drop in the primary windings due to changes in the exciting current and thus produce errors since the secondary voltage would be correspondingly changed. This effect is small, however since the primary winding has a resistance of only about 0.4 ohm and the current is usually between 1 and 2 amp. Moreover, the power factor of the sample is low so that this IR drop is very much out of phase with the impressed voltage. The reason for using auto-transformers for regulating the applied voltage instead of resistance is to keep the effect of this variable exciting current negligible.

A moment's consideration will show that changes in the calibration of the meters produce no errors in the test results. The only variable left is then the standard samples. Experience has shown that when properly mounted these samples do not change appreciably over long periods of time.

Checks on the Substitution Method

The first installation of this type has been in service for more than three years and thousands of samples have been tested with the apparatus. Every few months a sample is tested by this method and then checked on a sine-wave apparatus. A summary of the results over a three-year period follows: Maximum error = + 3.0 per cent; arithmetical mean = 1.05 per cent; algebraic mean = +0.25 per cent; number of samples = 32.

A laboratory using a large generator, giving approximately a sine wave of voltage, but with no harmonic booster, gave the following results on the same samples: Maximum error = —5 per cent; arithmetical mean = 1.34 per cent; algebraic mean = —1.06 per cent.

The large maximum error of 5 per cent was found to be due to a fault in one of the measuring instruments and was immediately corrected. During this time the meters for the apparatus have never been checked or overhauled, no changes have been made in the apparatus and the standard samples have not been rechecked.

HYDRO-ELECTRIC *energy in large, steady and dependable quantities can alone be looked to for any substantial or immediate improvement in operative conditions or for any material reduction in the cost of supplying power. Any lower costs of producing electricity through hydro-electric plants should be shared in an equitable manner between the consumers who provide the market for the energy generated and the company which makes the economies.*

Electricity is as old as the stars. But it is only within recent years that it has been made to work for man as his willing and untiring slave. The work has been progressively successful, but many failures have resulted and much seemingly profitless experimentation has had to be done before each step in advance could be taken in safety and security. We acclaim the success of the plans but we forget the failures that had to occur before success could be achieved. We can be sure, however, that the knowledge we have today of hydro-electric development is worth all it cost.—C. P. CUTTEN, appearing before the California Railroad Commission on behalf of the Pacific Gas & Electric Company.

Readers' Views and Comments

Water Power and Adequate Electrical Supply in Switzerland

To the Editor of the ELECTRICAL WORLD:

SIR: In no other country on the European continent has electricity made such progress during the last few years as in Switzerland. The universal scarcity of coal and the steadily increasing prices for all kinds of fuel have induced the Swiss authorities, especially the Federal Railway Administration, to push energetically and by all available means the installation of electric power plants on a basis hitherto quite unknown. On the St. Gothard Line, for instance, the whole section from Erstfeld to the Italian-Swiss station of Airolo, including the Gothard tunnel, has been worked by electricity for the past six months, while electric traffic on the section from Airolo to Biasca—a few miles from Bellinzona—was put into operation in the early part of December, 1920.

The Swiss authorities, and particularly the Swiss Water Board, the latter in its annual report just published, recommend the installation of a large number of new power plants, among which some will be constructed with the special purpose of storing large quantities of water for the winter season. The unusual dryness of this winter—the greatest experienced since 1820—and the entire absence of fresh snow up to altitudes of 3,000 m. (about 10,000 ft.) has forced several electric railway lines to reduce considerably the passenger and freight traffic, while the lack of water power was also deeply and often seriously felt in many industrial establishments.

A considerable number of large concessions for new plants have already been granted. Prominent among these are those in the Canton of Aargau for the Swiss Federal Railways, the Wildegg-Brugg concessions and those of the Northeastern Swiss power works at Gippingen. Among other prominent power plants now under construction may be mentioned those of the Lake of Lungern, the city of Zurich, the Bernese power works, the Fribourg state works, the Bündner, Nitom, Amsteg and Barberine power plants, the latter three being constructed by the Federal Railways, and the new plants of the Société des Forces Motrices de Chancy-Pougny, with a total capacity of no less than 400,000 hp.

It is a well-known fact that the so-called "greater navigation" of this country depends almost entirely on the construction of large power plants. A Swiss intercantonal net of navigation is imaginable only if it obtains an outlet to the sea. This question is on everybody's lips at present. As a matter of fact, it must be stated that great progress has been made in the navigation works of the river Rhone from the Lake of Geneva to the Mediterranean. The French government has just submitted to Parliament a project for the utilization of the Rhone with a view to producing power, promoting navigation and storing of water on a large scale. The energy available for this purpose amounts to 760,000 hp., or about 5,000,000,000 kw.-hr. per annum. It is further intended to make the river Rhone navigable all the way as far as to the Lake of Geneva. The connection between the Swiss lake of Langen and the north Italian interstate network of navigation at Milan is also being studied at the present time.

The problem of consolidating all the large water-power plants of Switzerland for the purpose of reciprocal distribution, mutual assistance and application of superfluous energy has also found its solution in the establishment of the Swiss Power Transmission Company. Most of the central and northeastern power plants have already joined this company in order to get the benefits which such interconnection undoubtedly offers.

In connection with this growing industrial activity in Switzerland it may be stated that as a result the demand for all kinds of electrical machinery and appliances is increasing, and though the country itself produces to a large extent the required installations, yet there ought to be a market for improved American apparatus. It is well known and appreciated here that the United States is leading the world in this respect.

HENRY L. GEISSEL.

Münsingen-Berne, Switzerland.

Financing Has Its Problems No Less than Engineering

To the Editor of the ELECTRICAL WORLD:

SIR: In the world of engineering today's dream is often tomorrow's fact—but not always. Perhaps nowhere is realization likely to lag further behind conception than in some of the colossal plans for hydro-electric development that every now and then are painted in rainbow hues to the astonishment of the layman and the joy of the builder of newspaper "scare heads." One hears, for instance, of how the tremendous potential sources of water power running to waste in Iceland are soon to be harnessed. The Icelanders are to supply the world with fertilizer and no doubt to become an industrial people into the bargain, manufacturing shoes and cloth for export even if they themselves stick obstinately to moccasins and furs. It is a great idea, but who is to supply the capital? Similarly the falls of the Zambezi could supply unlimited power to the South African cities if some benevolent billionaire would build the dams and put up nine hundred miles or more of high-tension transmission lines. But will he? The British Ministry of Transport recently announced with a resounding flourish of trumpets the working out of a scheme for building a barrage across the Severn River which would revolutionize the supply of electrical energy to English industrial centers. Probably quite feasible from a purely engineering standpoint, the English electrical journals comment, but where are the funds and would it pay? From continental Europe come so many accounts of great projects of a hydro-electric nature that it is impossible at this distance to distinguish the practicable from the visionary, but it may be shrewdly suspected that the goats outnumber the sheep. By the hard, mercenary test of profit all hydro-electric development, large or small, at home as well as abroad, will in the final event stand or fall, and electrical engineers must qualify themselves not only to overcome the problems of construction but to shed light on how the equally important problems of finance are to be met.

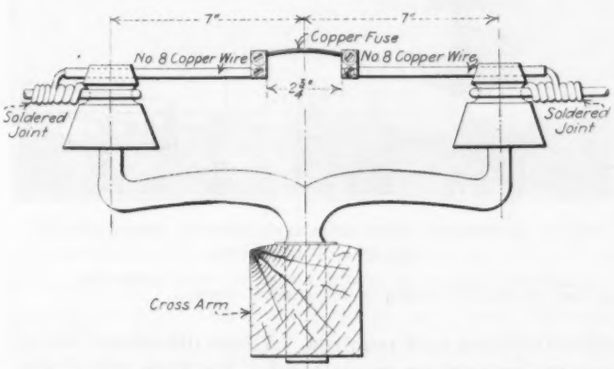
Brooklyn, N. Y. FRANK W. CHASE.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Safe and Economical Sectionalizing Fuse Block

SAFETY and lessened labor costs are attained by the type of section fuse shown in the illustration, which is used by the Denver Gas & Electric Company between banked transformers. The fuse mounting consists merely of an ordinary break arm on which the conductor is dead-ended from both directions. A piece of No. 8 copper is carried from each dead-ended conductor toward the center of the break arm, a gap of



VISIBLE FUSE BLOCK EMPLOYED BETWEEN TRANSFORMERS CONNECTED IN BANK

2¾ in. being left which is bridged by a copper wire fuse held in place by two small screw clips. This form of fuse has the advantage of (a) allowing inspection from the ground and elimination of unnecessary climbing by linemen, (b) elimination of the unsightly wiring to the ordinary fuse box, and (c) elimination of hazard that unnecessary wiring always creates for men called to work on the poles. The fuse is, of course, placed at the neutral point between banked transformers, and repeated blowing of fuses indicates the necessity of relocating the fuse.

R. A. HAMMOCK,
Superintendent of Distribution.
Denver (Col.) Gas & Electric Company.

Diesel Engines Used as Standby to Hydro Plants in Europe

ALTHOUGH water-power development has been more intensive in Europe than in the United States on account of the scarcity of fuel, Diesel engines have been installed at ends of trunk feeders or load centers served from hydro-electric plants as standby prime movers. These engines provide a source of energy without the ordinary standby losses, fully available within a few minutes' times and requiring few attendants for maintenance and emergency operation. A single operator will place such a plant in operation in two or three minutes for short breakdown service. From the accompanying table it will be seen that the size of the Diesel-engine plants ranges from 2,000 brake-horsepower to 5,200 brake-horsepower, two-cycle units being available in single cylinders as large as 2,000 brake-horsepower. One advantage of the Diesel engine is that it may be operated on very low-grade fuel. Tests indicate that

DIESEL ENGINES USED AS STANDBY PRIME MOVERS

City	Country	Size, Brake-Hp.	City	Country	Size, Brake-Hp.
Pont-a-Mousson	France	5,000	London	England	6,200
St. Chamond	France	3,000	Bombay	India	2,400
Villefranche	France	2,500	Bombay	India	3,150
Calais	France	3,300	Naples	Italy	4,650
Rive de Gier	France	3,500	Torre Annunsiata	Italy	2,100
Frouard	France	2,200	Bremen	Germany	6,000
Assailly	France	3,000	Alexandria	Egypt	3,800
Le Boucau	France	3,000	Kom-Ombo	Egypt	2,120
Etupes	France	4,500	Hongkong	China	3,300
Bordeaux	France	2,400	Belfast	Ireland	4,000
Yegoryevsk	Russia	2,250	Montevideo	Uruguay	2,880
Yaroslav	Russia	2,380	Namtu	Burma	2,000
Moscow	Russia	2,200	Lugano	Switzerland	2,300
Nizhni-Novgorod	Russia	3,200	Uncia-Oruro	Bolivia	2,200

some of these engines will produce approximately 465 kw.-hr. per barrel of low-grade Mexican and California oil. It is claimed that these engines operate on 0.45 lb. of fuel per brake-horsepower.

During the war fuel oil was not obtainable in many sections of Europe, so in 1914 Sulzer Frères of Switzerland built a small tar-distilling plant at Winterthur to supply their Diesel-engine plants with tar oil. Many cities followed suit, extracting a light tar oil from coal before burning it under boilers. According to reports the engines operated very satisfactorily with this fuel.

St. Louis, Mo. E. B. POLLISTER.

Increasing Effectiveness of Sand-Blasting Condenser Tubes

IN SAND-BLASTING condenser tubes some practices developed through studies by the maintenance section have proved of great value to the Philadelphia Electric Company. The sand for condenser cleaning was formerly dried by being placed on a steel plate with a fire under it and stirred until dry. This method has been superseded by steam drying, which requires no attendance. The drier is a receptacle with sides and bottom made of screening of a mesh that will hold wet sand but will pass dry sand. In this receptacle is a steam coil for heating the sand. The wet sand is placed in the drier and the steam is turned on; then as the sand becomes dry it sifts through the screen to the dry sand bin below.

A difficulty which was encountered at first in connection with sand-blasting was the return flow of gases into the condenser header where the men were working. This condition has been overcome by connecting the suction of a blower to the far-header during the cleaning, thus effectively preventing any return flow.

The experience of this company, like that of many others, has shown that sand-blasting is the most suc-

cessful method of cleaning condenser tubes. But, though effective, the method is slow. Only about fifty tubes per hour can be cleaned with the single nozzle now in use. The efforts of the maintenance section have therefore been directed toward increasing the speed of cleaning, and a multiple nozzle is now being developed to clean several tubes at one insertion.

F. C. RALSTON.

Philadelphia (Pa.) Electric Company.

Flexibility of Pulverized Fuel Control

THE flexibility of pulverized-fuel firing was illustrated recently in the boiler room of the Milwaukee Electric Railway & Light Company. In this plant each of the 468-hp. boilers is fed with pulverized fuel through two independent burners. On the occasion mentioned the feeder pipe between the pulverized-fuel bin and one of the furnaces became partly plugged just above the burner. Notwithstanding this, the boiler was operated for at least twenty-four hours at 120 per cent rating by increasing the feeder speed on the other burner. During this period the efficiency of combustion was undoubtedly below the average as the coal which did come through the plugged feeder was not accompanied by the correct quantity of air, but nevertheless service was maintained. Heavy loads are taken on or dropped off these boilers by simply adjusting the rheostats of the motors which feed the coal to the furnaces. Variations in the calorific value of the fuel are compensated for in a similar manner.

S. N. CLARK.

Chicago, Ill.

An Automatic Disconnecting Switch for Small Substations

FOR small substations the automatic feature and economy of the "skeet" switch have been so successful that this type of construction has been adopted as standard for stations under 1,000-kva. rating by the Georgia Railway & Power Company. This type of switch, as originally designed by T. F. Johnson, superintendent of the electrical department of that company, and described in the ELECTRICAL WORLD for Dec. 13, 1919, page 1066, has been improved by the use of the switch head shown in Fig. 1. Fourteen of these small stations equipped with the "skeet" switch, as shown in Fig. 2, are now operated on the system of the Georgia Railway & Power Company.

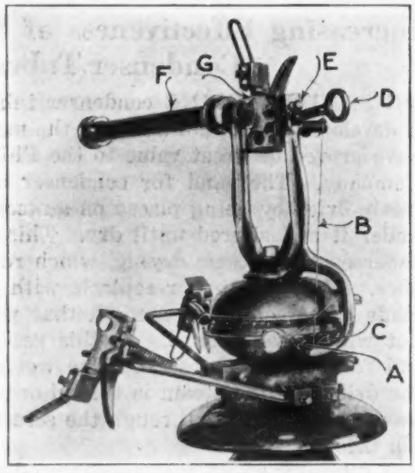


FIG. 1—HEAD OF "SKEET" SWITCH USED FOR AUTOMATICALLY DISCONNECTING SMALL STATIONS

The skeet head is an attempt to combine in one piece of apparatus the high-tension buses, air-break switch, fuse, switches for lightning arresters, disconnects for transformers, supporting structure, etc., at the same time reducing the number of insulators on a station to the minimum. This switch provides the protection of a fuse disconnecting switch, but at less expense owing to the smaller number of insulators and other parts of

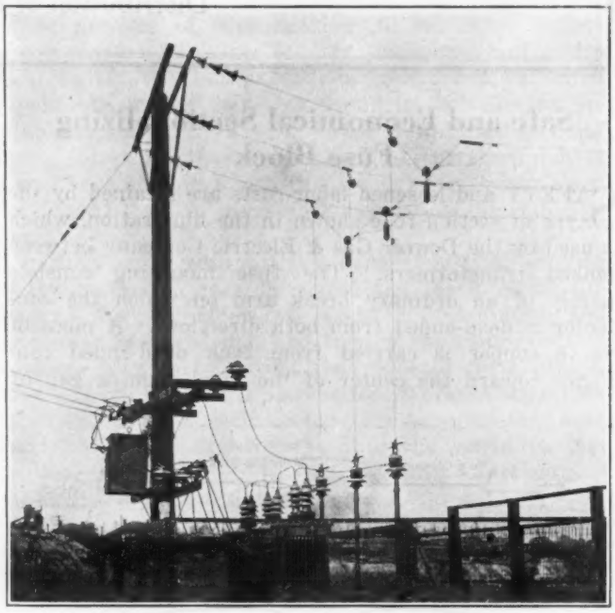


FIG. 2—AUTOMATIC DISCONNECTING SWITCH INSTALLED ON 150-KVA. SUBSTATION

A lightning arrester is usually placed at every substation. One has not yet been installed in the station shown.

substation structure required. A fuse disconnect switch requires supporting insulators for the fuse and a supporting frame, and moreover several sizes of switches must be carried in stock and several types of construction must be employed for different line voltages. The skeet head is the same regardless of voltage and only the usual dead-end insulators are required. Also the skeet head may be mounted directly upon the transformer bushing, thus reducing a transformer station to little more than the transformers and the skeet heads. This type of switch fills the gap between a fuse and an air-break switch, the chief advantage being its low first cost and the fact that the one type and size of head will meet all requirements on any small customer's substation. When it operates the melting of the copper fuse *A* forces an arc from the metal cap to the wire *B* about ☆ in. (1.6 mm.) at the point marked *C*. This relieves the catch *D*, which holds the pin *E* in normal position, so that a coiled spring in the tube *F* pulls the pin back suddenly and allows the Johnson switch *G* to be drawn up by the weights shown in Fig. 2, thus disconnecting the station from the line.

A quick snap in the breaking action of the switch is brought about by the amount of tension that is placed in the conductor marked (*b*) by the weight (*c*) in Fig. 3. A 15-lb. (6.8 kg.) weight will exert about a 7-lb. (3.1-kg.) pull on the skeet head (*a*) and provide the necessary quick start to prevent arcing and burning when the switch opens. The weight required, however, varies according to the height of the pole and the size of the conductor. The shorter the pole and heavier the line conductor the lighter the weight required, and the longer the pole and lighter the line conductor the heavier the weight to secure the desired spring action.

To insure operation when sleet is liable to form the connections of the switch leads to the line conductors are slid back from the vertical on the latter about 6 ft. (1.8 m.), so that when the switch operates the three switch conductors will swing away from the switch

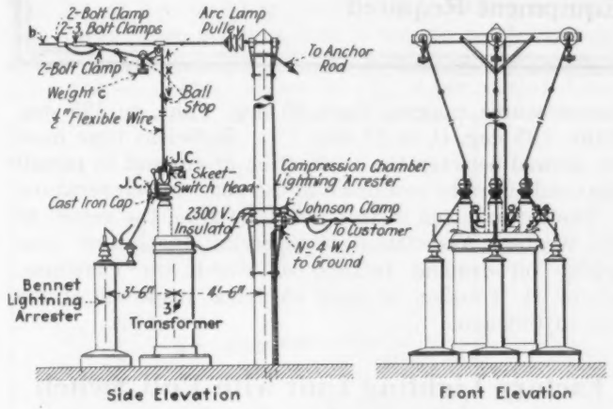


FIG. 3—CONSTRUCTION DETAILS OF AUTOMATIC "SKEET" SWITCH FOR SMALL SUBSTATIONS

Line Voltage	*Y, Ft.	Height of Pole, Ft.
11,000	5	30
22,000	6	30
38,000	8	35
44,000	10	35
50,000	12	40
66,000	15	40
110,000	20	45

*Distance from supporting pulley to lower ball stop.

head and thus insure the same safe breaking distance that exists when the flexible cables are drawn through the pulleys by the weights in a vertical position under normal weather conditions.

It has been the experience of the Georgia Railway & Power Company that a substation using this type of switch costs when installed as shown in Fig. 2, excluding transformers and lightning arresters, about $300. This amount includes all material and labor required. While installations are now being made with the switch head mounted on iron posts, as shown in Fig. 2, it is planned to adopt the construction shown in Fig. 3 at an early date and mount the switch head directly on the transformer terminal, making a very simple and compact unit.

Accident Hazards in Laying Conduit Underground

HAZARDS are present at all times during the laying of underground conduit, both to the employees and to the public. Goggles should be worn by all men when breaking concrete paving. Properly designed bull-point chisels, asphalt cutters and handles should be provided. These tools are serious hazards when their heads become "mushroomed." The burrs or chips which break off have caused painful and serious injuries. Properly designed handles are necessary to prevent workmen being hit on the hands or head with the sledge. There should be frequent and regular inspection of all tools and those found defective should be sent to the shop for repairs.

Picks should never be allowed to become round on the end. This not only retards progress but also causes accidents by the tool slipping and striking the workman on the foot or shin. Men working with them should not be closer than six feet to each other. They should be warned when working near conduit lines containing power or telephone cables and water and gas mains on account of the danger of driving a pick into them.

Conduit should be piled pyramidically, not over 4 ft. high, on the ground nearest the point at which it is to be laid.

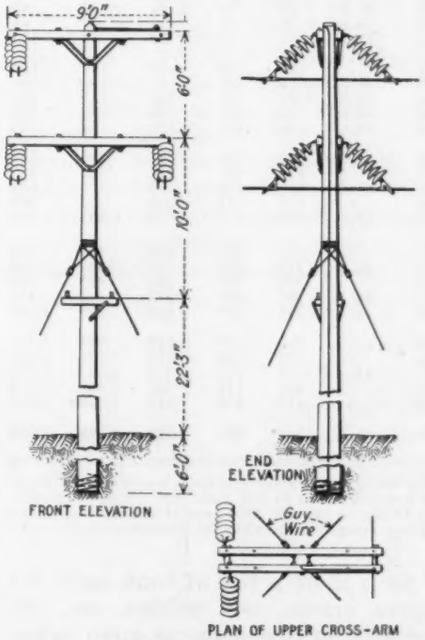
These remarks were made by H. W. Tueck, Commonwealth Edison Company, before the Public Utilities Section of the National Safety Council.

Two Transformers Used in Place of Damaged Balance Coil

THE diagram showing two transformers used in place of a damaged balance coil in the ELECTRICAL WORLD of Dec. 4, 1920, page 1121, would be satisfactory for an alternating-current system, but not for a direct-current system as stated. For a direct-current system the two outside wires connected to the three-wire load should be connected to the direct-current brushes of the machine and not to the slip-ring brushes as shown.

Construction Which Reduces Tension on Strain Insulators

TO AVOID the deterioration of insulators at points where tension assemblies are usually installed, the semi-tension assembly shown in the illustration can be employed as a substitute for the ordinary dead-end construction. In this assembly the conductor between the two strings of insulators is under tension so that a large proportion of the horizontal pull is taken by the conductor and the tension on the insulators is consequently lightened. In this assembly a clamp must be used that will hold the conductors up to breaking strength so that one-half of the assembly can swing to a tension position in case of a conductor break on either side. This gives a dead-end assembly when abnormal conditions require, yet leaves the insulators to carry a normal load no greater than that carried with a suspension assembly. This assembly can be used at railway and other crossings, at storm-guyed points and on spans greater than normal strength. Undue use of tension assemblies results in concentration of heavy normal strains at many points, while the use of the semi-tension assembly distributes the normal strains.



INSULATOR ASSEMBLY WHICH AVOIDS HEAVY STRAINS OF DEAD-END CONSTRUCTION

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Application of Demand Factor to Interior Wiring

IT HAS been found that in nearly all cases a demand-factor allowance may be safely applied to mains feeding a number of pieces of apparatus or a number of tenants in a building. In many cases a demand factor may also be applied to submains and it can sometimes be applied to the branch or final circuit where such circuit feeds a motor whose load is of an intermittent character. The carrying capacity of a wire as given in the code is based on the assumption that the conductor will carry its rated current indefinitely and in so doing will never exceed a certain temperature rise. However, where the current is on only for a short period of time, as in the operation of elevators, cranes, spot welders, etc., the current-carrying capacity of conductors as given in the National Electrical Code can be increased. The current-carrying capacities which have been found safe for different periods of time are given in the accompanying table for all common sizes of wire. This table is based on the use of three rubber-covered wires in conduit, with an ambient temperature of not more than 85 deg. Fahr. (35 deg. C.), and for other installations at ambient temperatures ranging from 85 deg. Fahr. to 125 deg. Fahr. (35 deg. C. to 52 deg. C.). Sufficient time must be allowed between the application of current to permit the conductors to cool down to the ambient temperature.

The information in this article is from the report of the Western Association of Electrical Inspectors' committee on demand factors, of which the chairman, Victor H. Tousley, is chief electrical inspector of the city of Chicago.

CURRENT-CARRYING CAPACITY OF CONDUCTORS FOR INTERMITTENT SERVICE

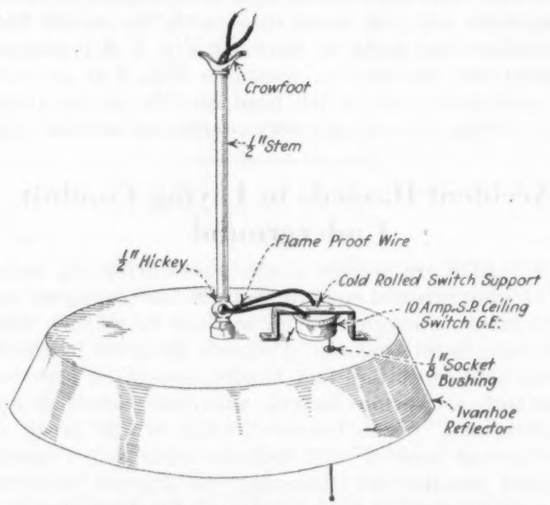
B. & S. Gage	Size Conduit for Three Conductors, In.	N. E. Code Carrying Capacity, Amp.	Actual Temp. Rise, Deg. Fahr.	Carrying Capacity, Amp., for 36 Deg. Fahr. Rise — Indefinite Time	Short Time in Minutes — 30	15	10	5
14	½	15	27.0	17	19	22	24	30
12	½	20	31.0	22	24	26	29	35
10	½	25	27.9	27	30	35	40	45
8	1	35	29.9	36	43	50	60	65
6	1	50	33.1	52	60	73	80	105
5	..	55	....	56	69	88	100	125
4	1¼	70	40.7	64	77	97	110	140
3	1¼	80	34.9	82	93	113	135	165
2	1¼	90	34.7	90	106	130	155	195
1	1½	100	39.1	96	126	154	180	225
0	2	125	41.2	110	147	182	210	275
2/0	2	150	41.8	130	179	220	260	340
3/0	2	175	39.4	150	213	270	320	420
200,000	..	200	....	175	247	310	355	480
4/0	2½	225	57.6	180	256	325	395	515
250,000	..	240	....	205	297	375	455	585
300,000	3	275	45.2	238	345	435	535	690
350,000	..	300	....	265	395	500	605	790
400,000	3	325	42.1	290	440	555	690	850
500,000	3	400	48.1	345	529	660	800	1,090
600,000	..	450	....	390	610	750	915	1,225
700,000	..	500	....	430	680	830	1,025	1,400
750,000	4	525	44.8	450	710	870	1,080	1,450
800,000	..	550	....	465	745	905	1,120	1,525
900,000	..	600	....	495	810	975	1,210	1,665
1,000,000	4½	650	55.2	525	870	1,040	1,295	1,800

This table is based on the use of three rubber-covered wires in conduit where the temperature of the air does not exceed 85 deg. Fahr., and for other installations at temperatures from 85 deg. to 125 deg. Fahr., and it is assumed that the current will always be off a long enough time to allow the conductors to cool down to the air temperature.

Factory Lighting Unit with Pull Switch Mounted on Shade

IN INSTALLING a lighting system using lamps of the higher wattages it is often desirable to connect a switch so that each unit may be controlled independently. In order to save time and extra wiring one large industrial plant has adopted the plan of placing the ceiling switch attached to a small bracket on the upper side of the metal shade, as shown in the cut. The supporting bracket is made of cold-rolled stock 1 in. wide x ⅛ in. thick and approximately 10 in. long (25 mm. x 3.2 mm. x 25 cm.). This material can be readily bent cold in a vise. These self-contained units are assembled with ceiling switch and flame-proof wiring complete and are carried in the electrician's stock ready for instant use.

This arrangement has been in use about two and one-half years and has proved its practicability in all details. In no case have we noted any breakage of filament due to the snap of the operating switch. It was found desirable to protect the operating cord where it passed through the metal shade with a ⅛-in. socket brushing.

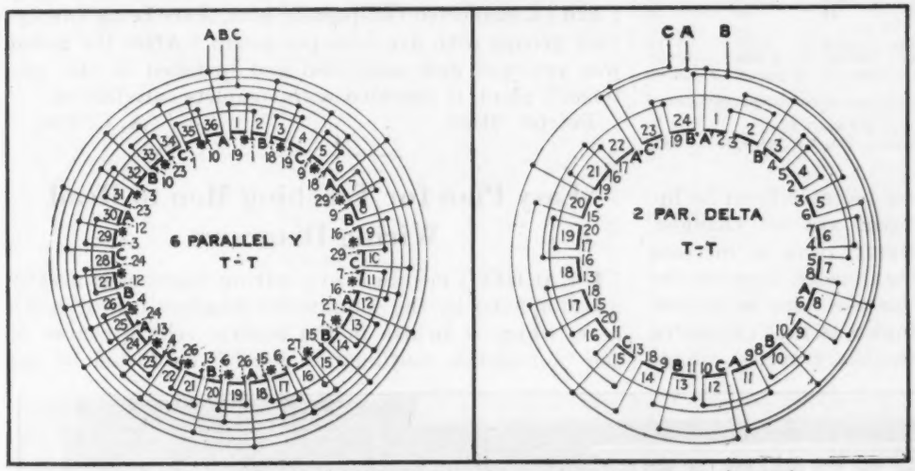


PULL SWITCH IS MOUNTED ON TOP OF REFLECTOR

I. H. GASKIN,
Shop Engineer.
Gillette Safety Razor Company,
Boston, Mass.

Increasing Speed and Horsepower of a Slip-Ring Induction Motor

A CHANGE of the speed and horsepower of a slip-ring induction motor was recently accomplished in one Eastern shop by rewinding both stator and rotor. The motor was a 50-hp., twelve-pole, 600-r.p.m., 220-volt, three-phase machine, and it was to be changed to a 75-hp., 900-r.p.m. motor. The connections before and after the change are shown in the accompanying table and diagrams. To develop the eight-pole stator winding the twelve-pole chord factor was first figured. With 180 slots and twelve poles the coil pitch is 180 ÷ 12 = 15 slots, or 1 and 16. Fifteen slots is therefore full-pitch, or 180 electrical degrees. Each coil, however, spanned only eleven slots or [(11 ÷ 15) × 180] = 132 electrical degrees. The chord factor was therefore, sin (132 deg. ÷ 2) = 0.914. If the motor were reconnected for a series-star connection, the line voltage would be 220 × 6 = 1,320 volts with this chord factor (0.914), and with full pitch it would be 1,320 ÷ 0.914 = 1.444 volts. Now if the poles were decreased from twelve to eight, the speed would increase from 600 to ((12 ÷ 8) × 600) = 900 r.p.m. If the magnetic conditions were the same, the horsepower would increase in the same proportion from 50 to ((12 ÷ 8) × 50) = 75 hp. This would mean that the voltage should be increased from 1,444 to [(12 ÷ 8) × 1,444] = 2,162 volts for the developed single-series star winding.

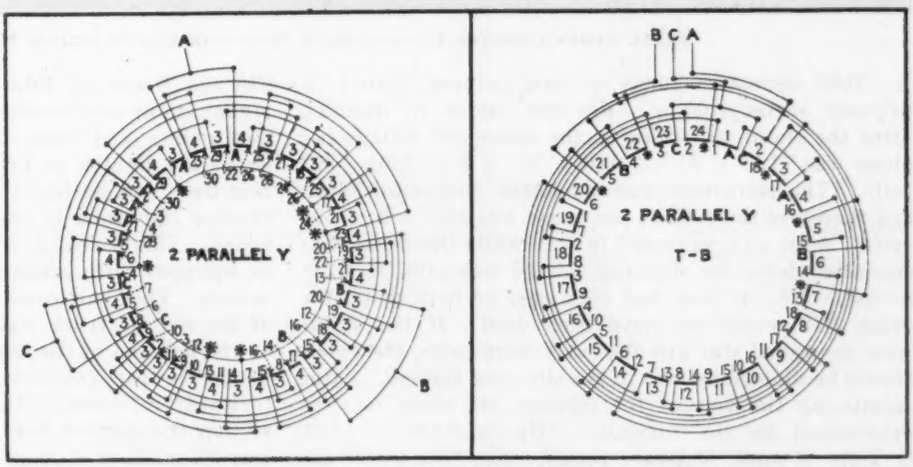


TWELVE-POLE STATOR (LEFT) RECONNECTED FOR EIGHT POLES (RIGHT)

To use the old winding for a line voltage of 220, it would have to be paralleled. For a star connection there should be 2,162 ÷ 220 = 9.83 parallel paths, which is impossible. The developed series-delta full-pitch connection would give 2,162 ÷ 1.73 = 1,254 volts. For 220-volt operation there would be 1,254 ÷ 220 = 5.7 parallel paths, which is also impossible. Therefore the stator had to be rewound.

In figuring the rewinding a series-delta winding for 440 volts was developed, as such a winding could be used in series on 440 volts or in two-parallel for 220 volts and the delta type of connection requires more turns, which would help get rid of the extra turns. The turns per coil required for such a winding and full pitch would be (440 ÷ 1,254) × 8 = 2.8 turns. Using a three-turn coil, the full pitch voltage would be ((3 ÷ 2.8) × 440) = 472 volts. This may be reduced to 440 volts by the proper chord factor, which is 440 ÷ 472 = 0.932. But 0.932 = sin 68.5 deg., and therefore the coil must span 2 × 68.5 deg. = 137 electrical degrees. But full pitch is 180 slots ÷ 8 poles = 22.5 slots, which equals 180 electrical degrees. Therefore the proper span is [(137 ÷ 180) × 22.5] = 17 slots approximately, which is a pitch of 1 and 18.

The area of copper was increased in the same proportion as the turns decreased. The original three No. 14 wires had an area of 3 × 4,106 = 12,318 circ.mils. Therefore the new wire should have an area of [(8 ÷ 3) × 12,318] = 32,848 circ.mils. Moreover, it had to fit the slot. The original No. 14 wire was laid three wide in the slot, giving a width bare of 0.192 in. Two bare No. 11 wires have a width of 0.192 in., and the area of one No. 11 is 8,234 circ.mils; therefore the number of wires in parallel per coil should be (32,848 ÷ 8,234) = 3.89, or four wires approximately, which would have an area of 4 × 8,234 = 32,936 circ.mils. With a coil two wide by six deep the height of the new coil is 6 × 0.091 = 0.546 in. against 8 × 0.064 = 0.512 in. for the old coil. The difference is only $\frac{1}{32}$ in., therefore the coil will fit in the slot. Accordingly the stator was rewound with 180 coils having three turns of four No. 11 wires in parallel wound too wide by six deep per coil and with a pitch of 1 and 18. The winding was connected two-parallel-delta with twenty-four phase groups, twelve groups having seven coils in series and twelve having eight coils, the eight-coil groups alternating with the seven-coil groups.



SLIP-RING ROTOR CHANGED FROM TWELVE POLES (LEFT) TO EIGHT POLES (RIGHT)

In developing the rotor winding it must be remembered that the horsepower varies with the ampere turns and the speed. As the speed will increase from 600 r.p.m. to 900 r.p.m. when changing from twelve to eight

DATA ON SLIP-RING MOTOR REWOUND FROM TWELVE-POLE TO EIGHT-POLE

	Stator		Rotor	
	Before	After	Before	After
Voltage	220	220	217	324
Ampere per phase	....	....	100.5	101
Horsepower	50	75	50	75
Revolutions per minute	600	900	600	900
Poles	12	8	12	8
Coils	180	180	120	120
Turns per coil	8	3	4	4
Size wire	3 No. 14	4 No. 11	3 No. 10	3 No. 10
Coils per group	5	*8–7	†4–3	5
No. groups	36	24	36	24
Pitch	1–12	1–18	1–10	1–13
Chord factor	0.914	0.932	0.988	0.955
Connection	6-par.–Y	2-par.–D	2-par.–Y	2-par.–Y

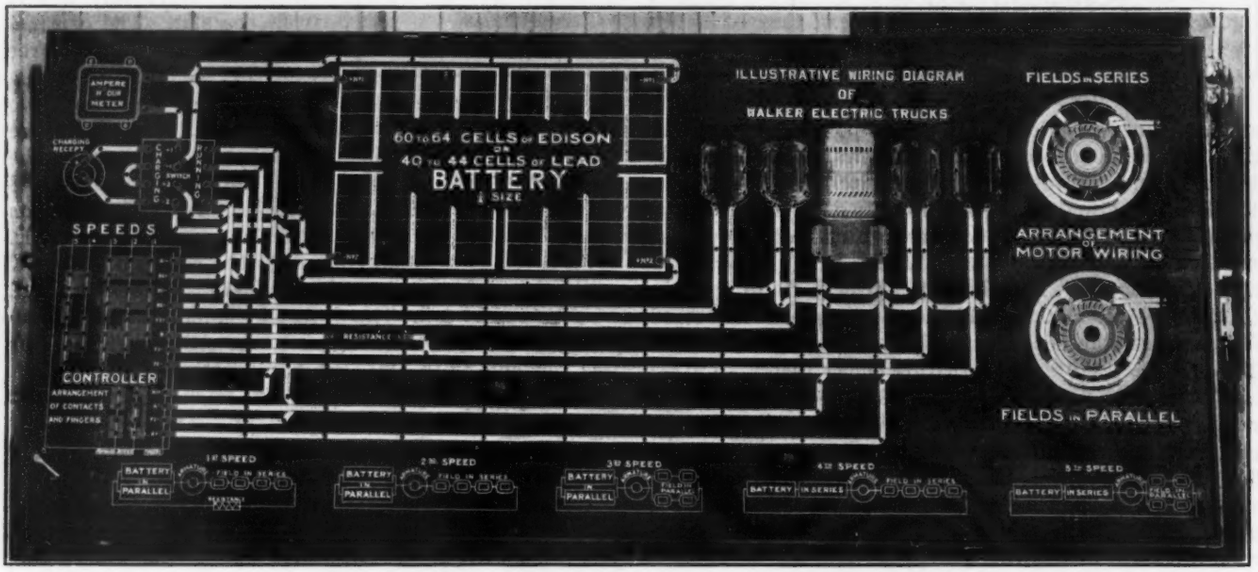
*Number of coils for successive groups is as follows: 8-7-8-7-8-7, etc.
† Number of coils for successive groups is as follows: 433, 334, 343, 433, 334, 343, 433, 334, 343, 433, 334, 343.

poles, the horsepower will likewise increase from 50 hp. to 75 hp. if the current and turns are not changed. Therefore the only change necessary was to increase the pitch to that required for eight poles, keeping the current and total number of turns the same as before. The voltage between collector rings was first calculated from the following formula: Secondary series voltage = (total secondary turns ÷ total primary turns) × primary series voltage. For the motor in question after the stator was changed the secondary voltage per phase was (120 × 4) ÷ (180 × 3) × 2 × 220 = 392 volts. The secondary was connected two-parallel-star, and therefore the voltage per phase was 392 ÷ 2 = 196 volts. As it was connected in star while the stator was connected delta, the slip-ring voltage was (196 × 1.73) = 340 volts. If both had been star or both delta, the value 1.73 would not have been used. If the stator were connected star and the rotor were delta, the result should be divided by 1.73 to get slip-ring voltage. After calculating the voltage the current per phase may be determined by the formula: (Hp. × 0.746 = 1.731 × volts × amp. × power factor. For this motor the power factor was 0.985 and therefore the secondary current would be (75 × 0.746) ÷ (1.73 × 340 × 0.985) = 96.5 amp. It was desired, however, to keep the current the same as before the change, or at 100.5 amp. Therefore a chord factor had to be found which would decrease the voltage and thus raise the amperes for the same horsepower. This chord factor should be 96.5 ÷ 100.5 = 0.96 if the power factor is considered unchanged. But 0.96 = sin 73 deg., therefore the pitch is ((73 ÷ 90) × 15) = 12.1, or twelve slots. This pitch, 1 and 13, gives a chord factor of sin [(12 ÷ 15) × 90] = 0.955, which gives a current of 96.5 ÷ 0.955 = 101 amp. and a slip-ring voltage of 340 × 0.955 = 324 volts. Accordingly the rotor was rewound with 120 coils of No. 10 wire three in hand, with a pitch of 1 and 13, connected two-parallel-star, there being twenty-four groups with five coils per group. After the motor was rewound and assembled and installed in the customer's plant, it operated with complete satisfaction.

Detroit, Mich. A. C. ROE.

Easy Plan for Teaching Men to Read Wiring Diagrams

TEACHING men to read a wiring diagram is greatly simplified by the illuminated diagram board shown here, which is in use in the electric vehicle course of the "automobile continuation school" conducted by the



SMALL LAMPS LIGHTING IN SUCCESSION HELP THE EYE TO FOLLOW THE DIAGRAM

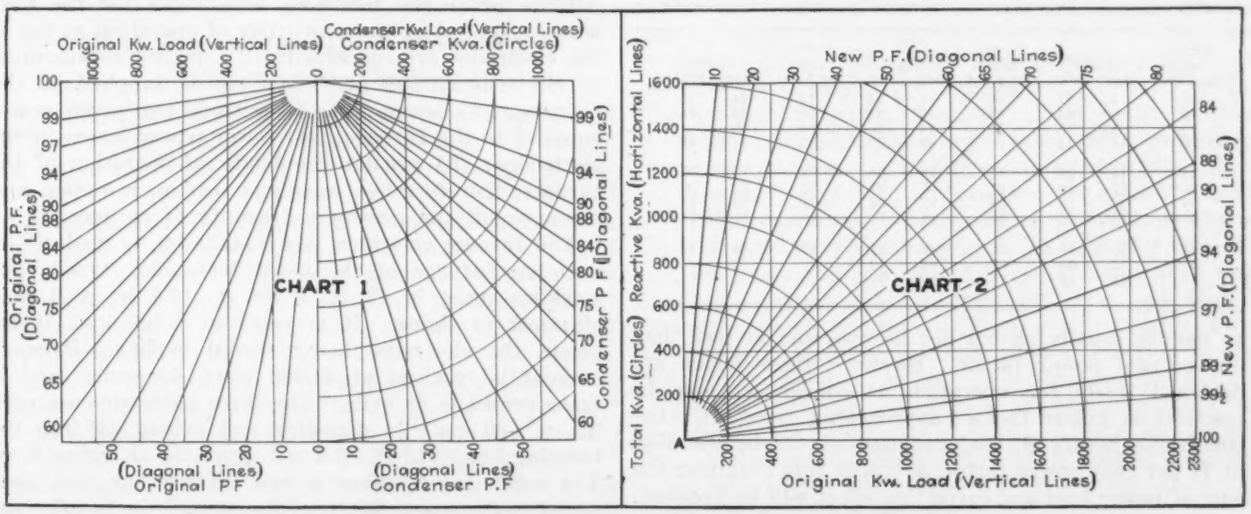
Chicago Board of Education. Telephone switchboard signal lamps are mounted in the board at various contact points and lines, representing conductors. The lamps are lighted in proper sequence, tracing the current flow from battery to motors and back to battery by turning the crank in the lower left-hand corner of the board. This drives a cylinder back of the board which is equipped with contacts similar to those on a sign flasher. This particular board illustrates the operation of an electric truck motor and control. An indicator on the left end of the board is used to shift the cylinder to the proper position for any desired truck speed, forward or reverse. The crank may be turned slowly so that the current flow is readily followed, or a pause may be made at each point. Energy for operating the lamps is furnished by a 10-volt storage battery.

J. E. Dunlap of the Walker Vehicle Company is responsible for the design of the board. R. Macrae of the Commonwealth Edison Company is the teacher in charge of the electric vehicle course.

Charts to Solve Power-Factor Correction Problems

FOR determining the size of synchronous motor necessary to raise the power factor of existing loads to different values the charts shown here have proved useful. They give at a single setting a clear view of all the results to be obtained with different sizes of condensers, either floating on the line for power-factor correction or carrying a mechanical load. The charts also give without calculation the kva. under both the original and the corrected conditions and the various values of the power factor of the load and of the condenser itself.

The reproductions are intended as a guide for any one wishing to make similar charts. In making them the angles between the 100 per cent power-factor line and the line for other power factors may be determined from the accompanying table or any table of cosines.


Original Kw. Load (Vertical Lines)
Condenser Kw. Load (Vertical Lines)
Condenser Kva. (Circles)
Original P.F. (Diagonal Lines)
Condenser P.F. (Diagonal Lines)
CHART 1
(Diagonal Lines) Original P.F
(Diagonal Lines) Condenser P.F
New P.F. (Diagonal Lines)
Total Kva. (Circles) Reactive Kva. (Horizontal Lines)
New P.F. (Diagonal Lines)
CHART 2
Original Kw. Load (Vertical Lines)

CALCULATION OF SYNCHRONOUS-CONDENSER SIZES FOR CORRECTING POWER FACTOR IS SIMPLIFIED BY USING THESE CHARTS

Both of the charts should be drawn to the same scale and at least as large as 8 in. x 10 in. Chart 1 should be on cross-section paper and Chart 2 on celluloid or other transparent material.

METHOD OF USING CHARTS

General.—For all purposes superpose Chart 2 on Chart 1 letting the point *A* (Chart 2) fall on the intersection of the ORIGINAL POWER-FACTOR line and the ORIGINAL LOAD line on Chart 1. Place the base lines of both charts parallel and hold them in this position by weights or otherwise.

I. *To determine condenser size needed to produce any desired power factor without carrying mechanical load:* Follow NEW POWER-FACTOR line (Chart 2) to ZERO POWER-FACTOR line (Chart 1) and trace nearest circle to CONDENSER KVA. scale (Chart 1).

II. *To determine size of condenser necessary to produce any desired power factor when carrying a mechanical load:* Follow NEW POWER-FACTOR line (Chart 2) to vertical line (Chart 1), indicating CONDENSER KW. LOAD, and trace nearest circle (Chart 1) to CONDENSER KVA. scale (Chart 1). The power factor at which the condenser will operate may be found by tracing the radial line on Chart 1, which passes through the intersection of the NEW POWER-FACTOR (Chart 2) and the CONDENSER KW. LOAD (Chart 1) to the CONDENSER POWER-FACTOR scale (Chart 1).

III. *To determine the total kva. supplied without a condenser:* Follow NEW POWER-FACTOR line (Chart 2) to ORIGINAL LOAD LINE (Chart 2) and from intersection trace circle on chart 2 to TOTAL KVA. scale.

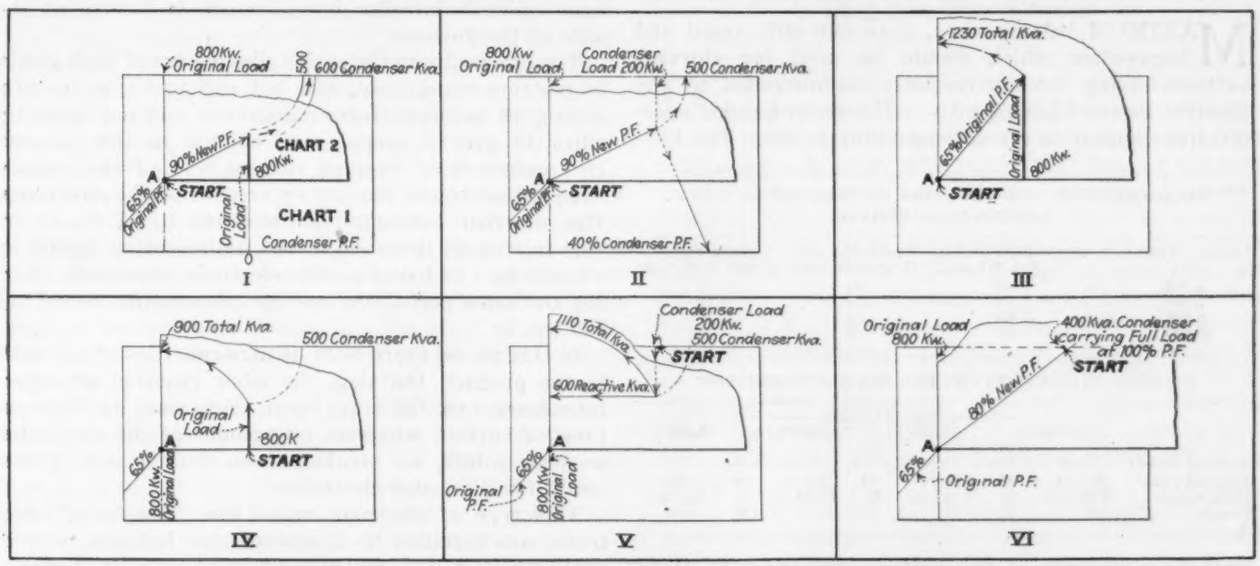
IV. *To determine total kva. supplied with condenser carrying no mechanical load:* Follow ORIGINAL LOAD ORDINATE (Chart 2) to CONDENSER KVA. circle (Chart 1) and from intersection trace horizontal line to TOTAL KVA. scale (Chart 2).

V. *To determine total kva. supplied with condenser carrying a mechanical load:* Follow vertical line indicating CONDENSER LOAD (Chart 1) to CONDENSER KVA. circle (Chart 1) and from intersection trace circle on Chart 2 to TOTAL KVA. scale (Chart 2).

VI. *To determine system power factor with condenser carrying full rating at 100 per cent power factor:* Observe power factor line Chart 2 passing through CONDENSER KVA. scale (Chart 1).

SIMPLIFIED DRAWINGS SHOWING SOLUTION OF VARIOUS CASES

Given a load (800 kw.) at a certain power factor (0.65)



I. Find condenser size unloaded to raise power factor (0.65) to certain value (0.90). Ans. 550 kva.

II. Find condenser size loaded (200 kw.) to raise power factor (0.65) to certain value (0.90). Ans. 500 kva.

III. Find total kva. without condenser. Ans. 1,230 kva.

IV. Find total kva. with unloaded condenser (500 kva.) Ans. 900 kva.

V. Find total kva. if condenser (500 kva.) loaded (200 kw.). Ans. 1,110 kva.

VI. Find total power factor with condenser at unity power factor. Ans. 0.78.

Chart 1 is drawn on cross-section paper, while Chart 2 is made on tracing cloth, celluloid or other transparent material. The small diagrams I to VI will give a pictorial idea of the method of solving different problems.

In choosing a condenser certain precautions must be observed. The condenser must not be operated at a power factor lower than that recommended by the manufacturer. Synchronous machines designed primarily

POWER FACTORS AND CORRESPONDING ANGLES OF LAG OR LEAD

Power Factor, per Cent	Angle Deg.	Min.	Power Factor, per Cent	Angle Deg.	Min.	Power Factor, per Cent	Angle Deg.	Min.
5	2	52	60	36	52	92	66	56
10	5	44	65	40	33	93	68	26
15	8	38	70	44	26	94	70	
20	11	32	75	48	35	95	71	48
25	14	28	80	53	08	96	73	45
30	17	28	82	55	05	97	75	56
35	20	29	84	57	08	98	78	31
40	23	25	86	59	19	99	81	54
45	26	45	88	61	39	99½	84	16
50	30	00	90	64	10	..	..	..
55	33	22	91	65	30	..	..	..

as motors usually should not be operated at less than 50 per cent power factor. However, those which are designed solely for operation as condensers may be operated at power factors approaching zero. If other conditions justify it, the condenser should be operated at 71 per cent power factor, as under this condition the sum of power load and correction effect will be greatest.

From a standpoint of gross economy, the cost of the condenser must be balanced against the possible benefits derived from raising the power factor, such as lower rates, released capacity of generators, lines, transformers, etc., and reduced voltage drop with consequent increased torque and efficiency of motors, etc. In practice it is rarely economical to raise an existing power factor above 85 per cent or 90 per cent on account of the excessive cost of corrective equipment large enough to give a higher power factor.

ALBERT RUDIN.

Matahambre, Cuba.

Standard Practice in Building Storage-Battery Mine Locomotive

MAXIMUM battery sizes, draw-bar pull, speed and horsepower which should be used for storage-battery mining locomotives were recommended by the Electric Power Club recently. The recommended specifications appear in the accompanying tables. The kilo-

RECOMMENDED CONSTRUCTION OF STORAGE-BATTERY MINING LOCOMOTIVES

Chassis Weight, Lb.	Draw-Bar Pull, Lb. Chilled Wheels	Speed, Miles per Hour at 80 Volts	Motor Horse-Power at 80 Volts
6,000	1,000	3½	11
7,000	1,500	3½	16
8,000	2,000	3½	22
10,000	3,000	3½	33

MAXIMUM SIZE BATTERY FOR MINE LOCOMOTIVES

	Size of Chassis						
	6,000-Lb.		7,000-Lb.		8,000-Lb.		10,000-Lb.
Make of Battery	Type	No. Cells	Type	No. Cells	Type	No. Cells	
Ironclad Exide..	MV-19	48	MV-19	48	MV-27	48	No
Philadelphia....	WML-23	48	WML-23	48	WML-33	48	limita-
Edison.....	A-8	88	A-8	88	A-12	88	tion

watt-hour capacity of the battery shall be kept at or below the kilowatt-hour capacity of the maximum-size battery specified for any particular make and for any size of chassis.

Continuous Self-Baking Electrodes for Electric Furnace

CONTINUOUS self-baking electrodes are employed in an electric ferro-manganese furnace of the Southern Manganese Corporation, Anniston, Ala. These electrodes are formed above the furnace and fed down through tubes for days at a time without any shut-down of the furnace. The results of the operation of this furnace prove the following advantages for the electrodes: (1) Absolute continuity of operation as far as the electrodes are concerned; (2) smaller consumption of electrode carbon per given power supplied to the furnace; (3) lower cost of electrode per given power supplied to the furnace; (4) lower power losses in the electrodes; (5) greater regularity of operation of the furnace, therefore less wear and tear on workmen and management and greater uniformity of product.

The furnace on which this installation is made is an open-top furnace of the usual ferro-alloy type. The working space is 12 ft. x 20 ft. (3.6 m. x 6 m.), elliptical in shape. It is rated at 1,800 kw., three-phase, the electrodes being spaced in line. Primary current is received at 44,000 volts, 60 cycles, and is transformed to 68 volts. The three electrodes are each 32 in. (80 cm.) in diameter and extend up into the tamping house, 12 ft. (3.6 m.) above the charging floor. The total length, when a new section has just been added to the top, is 24 ft. (7.2 m.), and the weight, exclusive of the holder, is about 13,200 lb. (6,000 kg.) per electrode. The casing is formed of No. 18 sheet iron (1.05 mm.), riveted together to the correct diameter and provided with inwardly directed partitions. One section 46 in. (115 cm.) long weighs approximately 110 lb. (50 kg.). Welding one section of casing into place takes one welder and one helper four hours. Tamping in about 2,000 lb. (900 kg.) of electrode mix with pneumatic rammers takes two men four hours, with one helper to carry mixture. A new section is required at each electrode every five to fifteen days, according to the nature of the ore being reduced in the furnace and the current taken by the electrode. Holders and electrodes are suspended by wire cables controlled by hand in the controller house, which is located at the side of the furnace.

The ore used was Caucasian dioxide ore of high grade, 56 per cent manganese, with not sufficient iron for producing 78 per cent ferro-manganese and not sufficient silica to give a proper slag volume in the furnace. In nineteen days' running current was off the furnace twenty-four hours, but not on account of the electrodes. The electrode consumption amounted to 21 ft. 2½ in. (6.4 m.) on all three electrodes, representing 10,600 lb. (45,600 kg.) of baked carbon electrode consumed. During the same period the energy consumption was 723,300 kw.-hr.

In this period there were no abnormalities of any kind in the product, the slag, the labor required or superintendence. On the other hand, there were no interruptions of current whatever on account of the electrodes, no poor joints, no breakages, no stumps, no "graveyard" for discarded electrodes.

This type of electrode, called the "Soderberg" electrode, was installed by Electrokenrisk Industri, a company which has operated such electrodes in Norway. The information was presented by G. W. Richards before the recent Cleveland (Ohio) meeting of the American Electrochemical Society.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Power of Regulation Involves Obligation to Protect

AS PART of the publicity program now being carried on by the Consumers' Power Company of Michigan in connection with its sale of preferred stock to customers, J. B. Wootan, director of publicity, has addressed within the past two months the Rotary clubs, chambers of commerce and other business organizations in about twenty cities served by the company. In these addresses he not only presents the reasons for the sale of stock but discusses in an interesting manner questions of public relations.

Basing his remarks on the proposition that "the power to regulate involves the obligation to protect," he reminds the public that when it assumes the right to regulate public utilities it thereby takes upon itself the obligation to protect that utility in its rights and privileges. It is pointed out that the public utility is fundamentally a mutual interest proposition and that the public first recognized this fact when it assumed the right to regulate the utility. Drawing an analogy between the franchise of citizenship and the franchise of the public utility, Mr. Wootan states: "When the state gives me my franchise as a citizen it imposes upon me under that franchise certain duties and obligations, but it bestows upon me certain rights and privileges for me to enjoy. The state sees that I cannot meet my obligations nor perform my duties unless I am fully protected in the execution of my rights and the enjoyment of my privileges. Therefore it very wisely throws about me an arm of protection and sees to it that I am fully protected in these rights and privileges so that I am able to become and remain a good citizen.

"Now, the same state confers upon me a franchise, which is nothing more nor less than a permit to do business, to carry on a public utility, and under this franchise the state imposes certain duties and obligations for the utility to meet, but it also bestows certain rights and privileges for the utility to enjoy. It is impossible for the utility to meet these obligations and duties unless it is fully protected in the enjoyment of its rights and privileges, and it is at this point where the state's obligation begins. It is here that the state must see that 'the power to regulate involves the obligation to protect' and that unless the state performs its part of this contract the utility cannot fully perform its part.

"Under this franchise the first duty imposed upon the utility is that of rendering adequate public service. It can do this by one means only, and that is by means of an adequate rate for the service. Therefore, while the primary duty of the public utility is to render adequate service, the primary duty of the state is to see that it gets an adequate price for the service. Here is the principle of mutual interest visualized. The community must have adequate service. It can get it by paying an adequate price. It follows therefore that the only kind of a public utility that is worth while to a worth-while community is a prosperous utility. When the question is asked, therefore: 'Why is it, if your securities are so attractive to investors, that you have to come now and then to the city commission or state commission and ask for an increase in your rates?" It, of course, answers itself. One realizes that the first principle of good merchandising is to see to it that the selling price is right, and also that the public utility's selling price must be right or it cannot serve, and that if the price is right the rate of return must be right. Furthermore, it is not a favor the utility is asking of the community when it applies for an increase in its rate for service; rather, it is a favor the utility is doing the community, or, still better, it is the utility keeping faith with the community, because the utility knows when the rate falls below a fair level and the public holds the power of adjusting the rate."

In all of his addresses Mr. Wootan emphasizes as the crux of the whole proposition that the public utility was designed to be a business enterprise and never a political football, a public servant that must serve, and that when it is dealt with as a political football or anything else other than a business enterprise it cannot adequately function as a public servant.

The speaker does not talk stock selling. He does, however, go into the needs confronting the company and the community and describes what the company is doing to meet these problems.

Depreciation, Amortization, Obsolescence and Similar Topics

BY KASSANDRA

DEPRECIATION, amortization, obsolescence, deferred maintenance, sinking fund, periodic payments—some of these terms are used at times interchangeably as if they represented exactly the same thing. What is very important is that they all have a common basis in that at the start there is a capital expenditure of some definite amount, call it *A* or *X*, $100 or 100 per cent. Then we look forward to some future time or date when this amount, *A* or *X*, $100 or 100 per cent, or whatever it may be, shall (on the same basis) be something like *B* or *Y*, or $20 or 10 per cent, or nothing at all. When the amount is nothing at all, then the full life of the property has been reached. When the amount at the end of this period is the scrap value, again the period of time is the useful life of the property.

All these terms of depreciation, amortization, etc., have to do with the idea that at the end of some period of time the property will be worth less than at the start and that during the period of life it is desirable to earn or set aside, over and above the dividends or interest

or fair return to the owners for the use of their property, a sum of money which will put the owners in the same position they occupied at the start.

Here the question of inflation or deflation comes in. If I had property worth $1,000 ten years ago which provided me with an income of $50 a year, or enough to buy a good suit of clothes at the prices then obtaining, what should I have today to be in the same position—$1,000, which will give me $70 a year at present interest rate, or $701.35, which at present interest rate will give me $50, the same I used to get, or $1,300, which at present interest rate will give me $91, just about enough to buy the same suit of clothes I used to get for $50?

It is obvious that this is merely a question of the bargain made. If I had $1,000 to be repaid at a later date, the borrower must return that $1,000. If I rent a house to be returned in good order and condition, I am entitled to a return of that house and nothing more or less even if its value has changed.

CAPITAL MUST BE FIGURED ON DOLLAR BASIS

The general opinion is that an investor in a public utility has loaned dollars, whether he owns common stock or bonds, and is entitled to a return of his dollars and on his dollars irrespective of inflation or deflation. This, however, is a matter not yet settled. Let us, however, figure on the dollar basis, since the dollar basis clearly does apply to all bonds and preferred stock and also applies to all book values which are essential in dollars. The point is that the difference between the initial and the final book value (in dollars) must be provided for during the life of the property.

If a property is worth, or rather is on the book for, $100,000 in 1920, and is going to be scrapped for $10,000 in 1940, then $90,000 must be provided during the life between 1920 and 1940. The straight-line method, so called, assumes that one-twentieth of the $90,000 is provided each year and returned to the owners each year. In this case their investment decreases each year and the cash payment for dividends decreases each year.

The sinking-fund method assumes that some less amount is provided each year, but instead of being returned to the owners at once, it is invested in a sinking fund which earns interest so that at the end of the twenty years it provides, together with the scrap value, enough to return the whole.

As a matter of fact, however, the life of any property is uncertain, and what is more important, its value does not decrease regularly so much each year, but very irregularly. An orchard appreciates during the time the trees are growing. Any business appreciates while it is being built up. An automobile appreciates just after it is bought, then depreciates very rapidly (in sale value) the moment it becomes second-hand, then depreciates more slowly. In the fall, when there is no buying demand, a second-hand automobile is not worth so much as it will probably be worth the following spring. The man who holds it during the winter expects even the second-hand automobile to appreciate enough during the winter to pay for storage charges, although in the spring he knows that it will depreciate in price during the summer even if not used at all. It follows that even if we know exactly the total life of a piece of property, it is almost impossible to say just how much it depreciates each year. We can see this if we carry the idea one step further and attempt to say just how much the depreciation was each month or day or hour.

If I should buy an automobile for $2,000 and use it one month, I might not be able to sell it second-hand for $1,500 and yet I probably would not sell it for $2,100 if it had turned out to be what I wanted, because I would not want to take the trouble of buying another and running the risk that it would not be so good as the first one. It would be stupid for me to mark off $500 on my books the moment the car became second-hand, and in fact there can be no rules applicable to all cases. The amount to be marked off for depreciation in each day or month or year is clearly a matter of judgment. The only rule to be laid down is that the whole amount must be marked off during the whole period, though it is reasonable that there should be a definite plan. The straight-line method calls for marking off the same amount each year.

The sinking-fund method provides for marking off nothing until the end, but accumulating enough to do all the marking off at once. This may be done by putting the same number of dollars into the sinking fund each year, but it may also be done by setting aside a portion of the gross earnings, or of the net earnings, or of the surplus over dividends, provided only that more is set aside to accomplish the work at the end of the period. The sinking fund may be built up at the start at the expense of dividends. In this case the dividends will be, apparently, very large toward the end.

Vice versa, all the profits over operating expenses may be paid out in dividends at the start. In this case when the property gets old all the earnings may be needed for the sinking fund if it is to provide for the return of the property after its life has ended. The dividends, in fact, may turn into "Irish dividends."

The whole thing is a matter of judgment, not of rules or of mathematics, and the best judgment would seem to be to pay at first as dividends or return on the investment just enough to attract capital, but no more than enough; then to put all the rest of the earnings into the sinking fund or reserve. This method should be followed for several years at least. When a better idea is obtained of the probable life and actual earning power, then the dividend should be revised and, of course, a change in the dividend means a change in the amount available for sinking fund in reserve.

HOW SHALL SINKING FUND BE INVESTED?

In the case of a utility, the change, when finally the life of the property can be more accurately forecast, may be in the rates or earnings instead of in the dividend. The question of whether a sinking fund or a reserve should be invested in the property or in outside securities is important, but important for reasons entirely different from those usually discussed. A sinking fund or reserve invested in bank loans or securities that are readily salable is just like keeping a big cash reserve. Such a cash reserve is extremely useful in case of a panic or squeeze, but if kept in a form to be really available, it is apt to command only a small interest rate—*i.e.*, to earn but a small return.

Except for availability in case of a panic, a reserve or sinking fund is best invested in the property itself. When so invested it is a little harder to see that it is earning interest just as much as the original investment, but it is earning interest just the same, even if the dividends are declared as a percentage on the whole investment. Often the actual reason for investing the reserve in the property is that in this way the surplus and reserve are mixed together and the books always

show a surplus. This is as it should be, since such a method by most laws permits dividends. In the case of a utility it is much more important that the return on the investment should be kept uniform so as to attract new capital than it is that the sinking fund or appropriation for reserve should be kept uniform. The commissioners can wisely provide for rates that will build up reserves in good times so as to keep rates lower in bad times; but, of course, it is essential that if reserve appropriations are kept low in bad times, they should be built up in good times.

One further point may be discussed, the claim of certain railroad people that utilities—or at least that their railroads—do not depreciate at all so long as they run. This is absurd, and yet the conclusion that no reserve need be accumulated has a modicum of reason in it. A railroad with its ties, tracks and equipment all half worn out may still function as well as if it were new, and its owners will be entitled to a return on their original investment. If, however, they are figuring that the road will last forever, they are taking a risk, and if the road disappears, they lose their all. It would be wiser for them to build up a reserve, and it would be wiser for the public (through the commissioners) to give them rates that will build up a reserve rather than have railroad rates and railroad dividends based on the theory that a railroad will last forever.

Turnpikes went, toll bridges went, some street railroads have gone, the waterworks of ancient Rome went. Why should American railroads last forever? This, like the other questions of depreciation, amortization and obsolescence, is a matter of judgment.

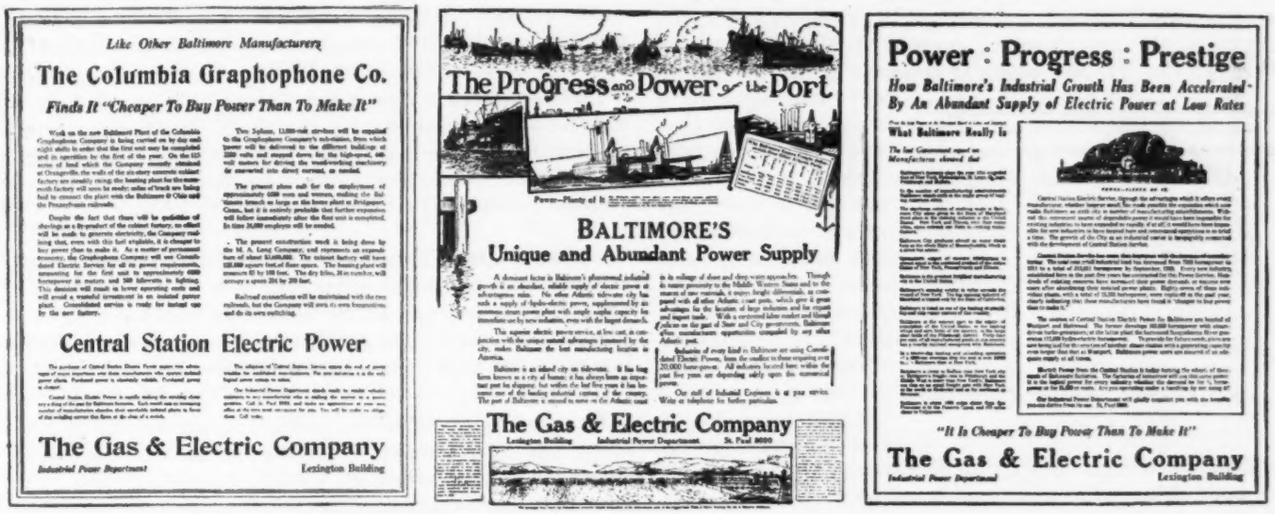
The owners of the property, together with the public and the commissions, whose power to fix rates make them the real owners, must figure the future as nearly as they can. They must fix rates, dividends and reserve or sinking fund so that in the final event every one shall have been treated fairly. Further, as fast as more definite knowledge of the future is obtained rates, dividends and sinking funds or reserves must be adjusted accordingly.

There is no general rule except that all these rates, dividends and reserves must be considered together as well as separately. Rates must be low enough to get the business and yet high enough to pay dividends and reserve. Dividends must be high enough to attract capital—the capital of the workingman who has saved. Sinking fund or reserves must be high enough to protect the capital of the man who has worked and saved, but sinking fund and reserve need not be figured on any mathematical basis, or, if so figured, the capital of the workingman must be preserved in accordance with the understanding under which he saved and invested.

The question of what should be done in view of various tax laws and also in view of various rulings of commissions is sometimes raised. This is something that cannot be dealt with generally. Each company, according to the tax laws by which it is governed and the rulings of its commission, must do the best it can and use its best judgment in each case.

City's Industrial Growth Depends on Power Supply

HOW the industrial growth of a city depends to a large extent on the adequacy of its electric power supply is the chief topic in a series of full-page advertisements which the Consolidated Gas, Electric Light & Power Company of Baltimore has been running in the daily papers as part of its industrial power campaign. In the three typical advertisements shown here the relation of power supply to the city's growth is emphasized and the details of an exclusively electrical installation in one of the large industrial plants are given to demonstrate that it is "cheaper to buy power than to make it." In all of the advertisements the progress and development of the city is coupled with the service rendered by the electric utility.


Like Other Baltimore Manufacturers
The Columbia Graphophone Co.
Finds It "Cheaper To Buy Power Than To Make It"
Central Station Electric Power
The Gas & Electric Company
Industrial Power Department
Lexington Building
The Progress and Power of the Port
BALTIMORE'S
Unique and Abundant Power Supply
The Gas & Electric Company
Lexington Building
Industrial Power Department
St. Paul 8000
Power : Progress : Prestige
How Baltimore's Industrial Growth Has Been Accelerated By An Abundant Supply of Electric Power at Low Rates
What Baltimore Really Is
"It Is Cheaper To Buy Power Than To Make It"
The Gas & Electric Company
Industrial Power Department
Lexington Building

TYPICAL ADVERTISEMENTS USED BY BALTIMORE COMPANY IN ITS INDUSTRIAL POWER CAMPAIGN

Ninety per Cent of Employees Are Stockholders

NINETY per cent of the 1,200 employees of the Iowa Railway & Light Company have become stockholders in the company as the result of a recent "drive." Stock was sold to employees at a slight discount, while other subscribers paid the par value. Seven per cent preferred was offered to employees, who paid for it either in cash or on semi-monthly payments of $5 per share. For the past year the company has offered its preferred stock to customers on weekly or monthly payments and many are now holders of the securities.

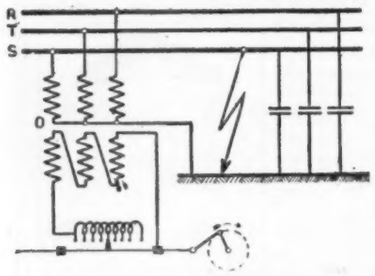
Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

The Arc Generator as an Engineering Mechanism.—Details of construction and control equipment for the Elwell-Poulsen arc generators for radio communication.—London *Electrician*, Dec. 3, 1920.

The Quench Transformer.—One of the reasons why a flash-over on a line insulator is so dangerous when it occurs on a transmission system of great electrostatic capacity is that the high charging current of the line tends to maintain a power arc across the insulator. An ordinary arcing ground suppressor cannot be relied upon to quench the arcing ground if the capacity exceeds a certain value. Professor Petersen in Darmstadt has found that arcing grounds are very effectively quenched if the transformer neutral is grounded through a large choking coil with an inductance such as to give resonance with the line capacity. The choking-coil current and the line-charging current then will both pass through the arc, but, being of opposite phase, will cancel out, leaving only a small residual current, which usually is not sufficient to sustain the arc. Another similar device, the so-called quench transformer, has been proposed by R. Bauch. It consists of an ordinary star-connected transformer, grounded at the neutral point, which is provided with an extra winding in the form of an open delta. The auxiliary winding is closed through an inductance coil as indicated in the figure. When a flash-over occurs on either line in the three-phase system, the field distribution in the transformer will be strongly distorted and an equalizing current will be set up in the auxiliary winding. This current, owing to the effect of the inductance coil, will have a strongly lagging phase displacement with respect to the primary voltage. A corresponding current will pass through the primary neutral to ground, and if the choking coil has the right value of inductance, the grounding arc will be quenched in much the same way as if the transformer had been grounded through a Petersen coil. The Bauch transformer is said to be very easily adjusted to suit the line capacity, but for systems where the capacity is frequently changed by switching operations an arrangement is recommended whereby the choking coil may be periodically changed from one extreme value of inductance to another within a time of three seconds. An arcing ground thus is quenched after three seconds at most, whatever value the line capacity happens to have at the moment. It is not necessary to use a special transformer for arc quenching, an ordinary three-phase transformer with a Bauch auxiliary winding giving just as good service even when it is at the same time used in ordinary operation. — *Elektrotechnische Zeitschrift*, Oct. 21, 1920.



BAUCH QUENCH TRANSFORMER FOR ARCING GROUNDS

Lamps and Lighting

Lighting of Shoe Factories.—A. L. POWELL and J. H. KURLANDER.—A study of the various operations performed in shoe factories, in order to determine how the lighting can best be laid out to meet manufacturing requirements. The writers hold that there is still room for investigation along this line.—*Transactions I. E. S.*, Nov. 20, 1920.

Calculation of the Lighting Installation.—A. S. TURNER, JR.—Three principal methods are explained for use in calculating illuminations, (1) point-by-point method, (2) flux-of-light method, (3) modified flux-of-light method. Extensive curves and tabular data for practical applications are included.—*Bulletin L.D.-117, Edison Lamp Works*, June, 1920.

United States Army Searchlamps.—CHESTER LICHTENBERG.—A comprehensive article giving the most important development in army searchlamps, mostly portable, for such exacting service as locating airplanes.—*Journal Franklin Institute*, November, 1920.

Generation, Transmission and Distribution

Wooden-Pole Design.—H. OTT.—A line diagram, or abaque, is presented which permits a rapid determination of necessary cross-section of wooden transmission-line poles for given span, conductor area and pole length.—*Elektrotechnik and Maschinenbau*, Oct. 24, 1920.

German Power Practice.—Modern power-plant operation was discussed at a meeting of German engineers some time ago. One of them, in dealing with the insulator question, said that deterioration of cemented insulators of the pin and cap type is caused by the different thermal expansion coefficient of cement and porcelain. In modern insulators, however, the thermal expansion has been made almost equal by mixing the cement with crushed porcelain. Another engineer, in reporting on transmission-line practice, said that the greatest strain to be permitted in copper conductors is 16 kg. per square millimeter (22,700 lb. per square inch). For span length 250 m. (820 ft.) is an upper limit, and strain poles should be not more than 1 km. (0.62 mile) apart. Taking into consideration the tendency to develop corona, the speaker suggested the following data for high-tension lines:

Voltage	Area		Distance Between	Phases
	Sq.Mm.	Circ. mils	Meters	Feet
160,000	35	69,000	2	6.56
100,000	70	138,000	2.5	8.20
50,000	150	296,000	3	9.84

A number of important details, such as protective apparatus, methods of grounding, etc., were discussed by other speakers.—*Elektrotechnische Zeitschrift*, Aug. 26, 1920.

Coal - Saving in the Chemical Industry. — DAVID BROWNLIE.—Here are given the results of investigations carried out during the last nine or ten years into the working of the steam-boiler plants of sixty different chemical works in Great Britain. The net working efficiency of these sixty plants proved to be only about 58 per cent and it is contended that by scientific control this could have been readily made about 72½ per cent. Complete details of the sixty plants tested are appended to the article.—*London Chemical Trade Journal,* September, 1920.

Power Distribution in Southern Sweden.—HALDEN.—Skane and Blekinge, the two southernmost provinces of Sweden, are supplied with electrical energy from hydraulic power stations belonging to two companies, Sydsvenska Kraft A.B. and Hemsjö Kraft A.B., which have recently combined their interests. The Sydsvenska power company, having developed several falls in the River Lagan, with an installed machine capacity of 19,000 kw., distributed in 1919 about 110,000,000 kw.-hr. over its 50,000-volt lines. A part of this energy was delivered to Danish consumers by way of a 25,000-volt submarine three-phase cable between Helsingborg and Helsingor. The Hemsjö company at present controls about 10,000 kw., the figure soon to be raised to 52,000 kw. Last year's total of delivered energy was 40,000,000 kw.-hr. Even after a complete hydraulic development of all available water power, the energy supply in southern Sweden will not be sufficient to meet the demand, and it is therefore proposed to link up the private power distribution system in the south with the big state-controlled hydraulic power station at Trollhättan by a 120,000-volt trunk line.—*Elektrotechnische Zeitschrift,* Oct. 28, 1920.

Rapid Determination of the Current Distribution.—S. AUSTEN STIGANT.—A device for the rapid determination of the current distribution on the line side of a three-phase interconnected-star static balancer operating on a four-wire system.—*Journal Institution of Electrical Engineers, London,* October, 1920.

Pulverized Coal as Fuel.—LAWFORD H. FRY.—A brief survey of the principles involved in the use of pulverized coal as a fuel, showing that common sense and recognition of these principles are more important than adherence to any special type of installation. The author discusses the subject in relation to the use of powdered fuel in the cement and metallurgical industries and also on locomotives and stationary boilers.—London *Engineering,* Nov. 12, 1920.

Traction

Railway Electrification in Austria.—On July 23, 1920, the Congress of the Austrian Republic decided to begin immediately a systematic electrification of the Austrian state railroads. That day a bill was passed which contained not only a detailed program of the work but also a long technical supplement stating the more important engineering considerations of the proposition. The work is to start at once on certain important railroad stretches in mountain districts, aggregating about 652 km. (405 miles) and representing a total yearly transportation, according to 1913 statistics, of 1,765,000,000 gross ton-km. (1,080,000,000 ton-miles). The electrical energy consumption is estimated at 119,500,000 kw.-hr. a year. This first part of the electrification program is to be completed in the years 1920-1925 and the sum of 5,096,000,000 Austrian crowns has been reserved for the work. According to an estimate, the expense will be absorbed as follows: Power plants, 452,000,000 crowns; distribution lines and substations, 1,560,000,000 crowns; electric locomotives, 2,260,000,000 crowns; alterations of present plant and other costs, 824,000,000 crowns. The work is to be carried out with complete electrification in view, and it is proposed in the next twelve or fifteen years to extend the electrification to a second group of lines with a total length of 1,136 km. (700 miles), a transportation total of 2,213,000,000 ton-km. (1,350,000,000 ton-miles), and an energy consumption of 238,000,000 kw.-hr. a year. After completion of this second stage of the work, the electrification will embrace 40 per cent of all the state lines. The necessary electrical energy is to be supplied from a number of hydraulic stations, the state having acquired the water rights of twenty-four waterfalls aggregating 125,000 hp. During the first construction period four power stations will be erected, namely, at Spuller-See, Rutz, Stubach and Mallnitz, with a total generating capacity of 96,000 hp. The power is to be distributed at 50,000 or 60,000 volts to substations along the road. The system adopted is single-phase supply at a frequency of 16⅔ cycles, and a contact-wire pressure of 15,000 volts. A detailed account of the electrification bill and its technical supplement is to be found in the *Elektrotechnik und Maschinenbau,* Oct. 9, 1920.

Automatic Substations for Alternating-Current Railway Signal Power Supply—I.—H. M. JACOBS.—This is the first of two articles which describe the application of automatically controlled equipment to railway alternating-current signal substations for the purpose of maintaining an effectively continuous supply of power to the signals. The present article deals with that type of substation in which the reserve power supply is a secondary commercial source, either nearby or distant, and the concluding article treats of the equipment used in the substation in which a storage battery and converting apparatus constitute the reserve supply. —*General Electric Review,* November, 1920.

Installations, Systems and Appliances

Heat Losses Through Electrodes of a Six-Ton Heroult Furnace.—M. R. WOLFE and V. DE WYSOCKI.—The total heat in the cooling water required to maintain the electrodes at constant temperature was 123.1 kw. Since 650 kw. was supplied to the furnace, the total electrode loss is 18.7 per cent of the power used. It appears from the investigation that a total of 18.5 kw. was absorbed by the upper cooling contact holders, leaving 104.6 kw. absorbed in the lower water-cooled rings.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Motor-Control Equipment and Its Application.—G. J. KIRKGASSER and E. W. SEEGER.—This is the first of a series of articles on the principles and application of motor-control apparatus.—*Electrical Review,* Nov. 27, 1920.

Heat Content of Steel and Slag from an Electric Furnace.—A. M. KUHLMANN and A. D. SPILLMAN.—Calorimetric determinations of the heat content of liquid steel and liquid slag from a 6-ton Heroult steel-casting furnace; also determinations of the heat capacity of the solid slag.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Variable-Speed Induction Motors for Centrifugal Pumps.—M. L. ENGER and W. J. PUTNAM.—It is shown

that a large saving in the power required to drive centrifugal pumps might be made if designers and operators would employ variable-speed drive to control pump discharge and not rely entirely on throttling.—*Engineering News-Record*, Dec. 9, 1920.

Electrophysics and Magnetism

Electrical Phenomena Occurring at High Levels in the Atmosphere.—S. CHAPMAN.—The author gives an account of a recent study of electricity and magnetism in the light of modern understanding of the constitution of matter.—*Journal Institution of Electrical Engineers*, October, 1920.

On the Electron Theory of the Metallic State.—G. BORELIUS.—The common theory assumes that conducting electrons move freely among the atoms of metal and have the same mean kinetic energy as gas molecules at the same temperature. It is said, however, that other consequences of this theory cannot be said to agree very well with experimental facts. By radical alterations in the fundamental assumptions the author discusses thermo-electric phenomena, the thermal and electric conduction and the magnetic and galvanomagnetic phenomena in the light of his revised theory.—*Philosophical Magazine*, December, 1920.

The Constitution of the Nickel-Iron Alloys.—D. HANSON and HILDA E. HANSON.—An investigation into the constitution of the nickel-iron alloys in which special attention has been given to (1) the determination of the effect of small quantities of nickel on the critical points of pure iron, and (2) an examination of Osmond's theory of the nickel-iron alloys and the determination, if possible, of the "stable" diagram of these alloys.—London *Engineering*, Nov. 5, 1920.

Units, Measurements and Instruments

Spark-Over Voltages Through Air.—W. S. FLIGHT.—Published data connected with the spark-over voltages through air have been carefully examined and additional tests carried out where no information was available or the previous results were inconsistent. Some of the factors which must be taken into consideration are spark length, shape of the conductors, proximity of grounded objects, shape of the insulator, density of the air, impurities, rain, composition of the insulator, electrical characteristics of the circuit, duration of application of the voltage, initial ionization and dielectrics in series.—*Beama*, November, 1920.

Electromagnetic Heat Treatment of Carbon Steel.—LANCELOT W. WILD.—The author first points out the necessity for a very accurate control of temperature during the heat treatment of carbon steel. The advantages of electric furnace heatings for this purpose are pointed out. One type of control of temperature for these furnaces is described, also a detector which depends upon the magnetic properties of the steel being heated.—London *Electrician*, Nov. 12, 1920.

Telegraphy, Telephony and Signals

Some Characteristics of the Frequency Doubler as Applied to Radio Transmission.—T. MINOHARA.—A general analysis is given of the theory of the ferromagnetic frequency doubler. The production of secondary circuit energy is secured either by the induction of a sinusoidal secondary emf. or by the production of a sharply peaked "impulsive" secondary emf. In each case secondary resonance is employed to emphasize the desired double frequency. The sinusoidal-wave and impulsive-wave systems are oscillographically studied and compared for different types of secondary load. The impulsive system is recommended as having higher efficiency wherever the frequency is sufficiently low to avoid excessive iron-core losses with that form of wave.—*Proceedings Institute of Radio Engineers*, December, 1920.

Automatic Telephony.—J. H. REYNER.—Three principal systems of automatic telephony are discussed as follows: (a) When the power required to operate it is supplied by electromagnets (Strowger and Siemens systems); (b) when the power is obtained by clutching electromagnetically to a continuously revolving shaft (Lorimer and Western Electric systems); (c) when no moving parts other than relays are employed (relay automatic).—*Beama*, November, 1920.

Miscellaneous

Physical Characteristics of Specialized Refractories.—M. L. HARTMANN, A. P. SULLIVAN and D. E. ALLEN.—Tests of the electrical resistivities of nine commercially used refractory materials at temperatures up to 1,500 deg. C. Measurements were taken while heating up slowly and while cooling down slowly, the thermocouple measuring temperature being outside the specimens. The amount of temperature lag thus involved was approximately determined. The results are necessarily only approximate, but show the relative resistivities of the different materials and the general order of magnitude of their resistivities up to 1,500 deg. C.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Ice Diversion on St. Lawrence River.—BENJAMIN F. GROAT.—The writer gives the results of his operation for two winters of a submerged weir construction for ice-diversion works in the South Sault Channel of the St. Lawrence River.—*Canadian Engineer*, Nov. 25, 1920.

The Work of the Société Hydrotechnique and Its Electric Map of France.—The Société Hydrotechnique was founded in France in 1912 for the purpose of carrying out research in hydraulic engineering. The society has established two research laboratories, in connection with the universities in Grenoble and Toulouse, where studies of a scientific nature are conducted. At the experiment station at Beauvert, not far from Grenoble, there are facilities for work on a scale comparable with conditions of practice. Investigations are now under way, for instance, on methods for water-flow measurement and for determination of turbine efficiency. We have recently referred to the valuable contributions to the theory of hydraulic surges which have come forth as a result of the work of one of the sub-committees of the Société Hydrotechnique. Another committee recently has worked out for publication a map of France containing all existing electric plants and distribution systems. The map is issued in eighty-six sheets, to the scale 1: 200,000, but there is also a smaller edition, in the scale 1: 500,000, which comes in four sheets. The output and voltage of every generating station is indicated on the map, as well as the type of current transmitted and whether the station is hydraulic or thermic. The electric map, however, does not give the topographical details, but is printed on transparent paper and is intended to be put on top of the ordinary map. The map covers more than 1,200 plants. It may be revised at any time by comparison with a standard copy which is constantly kept up to date by the committee.—*Comptes Rendus*, June 24, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Cincinnati Company Creates Permanent Financial Structure

LOOKING to the establishment of a permanent financial structure sufficiently flexible to meet varying conditions which may arise in the future, the stockholders of the Cincinnati Gas & Electric Company have approved the proposal of the company to authorize an issue of $50,000,000 prior lien and refunding bonds running forty years with sinking-fund provisions. The bonds will be issued at such times as the company's financial needs require and will bear such interest as the market conditions at the time of sale call for. Of the $50,000,000 issue $15,000,000 is set aside to refund present outstanding obligations.

In talking with a representative of the ELECTRICAL WORLD regarding the new issue, W. W. Freeman, president of the company, stated that it does not at present contemplate an extensive new construction program involving a large expenditure of capital. "This $50,000,000 authorization has been made," said Mr. Freeman, "to provide a more flexible form of security than we have outstanding at present. No definite interest rate has been stipulated, but under the provision of the bond the company can issue a series of the securities at an interest rate to conform with the then existing market conditions, which will do away with excessive discounts on a 5 per cent or 6 per cent bond when high interest rates are prevalent. A callable feature is also included whereby a series of the bonds bearing a high interest rate can be called in should conditions so indicate.

"This plan will enable the company to issue securities to meet new capital expenditures from time to time in the required amounts and at the necessary interest rates without having to draw up a new form of indenture each time."

Surcharge and Fuel Charge for Cambridge Maximum-Rate Customers

A SURCHARGE of 1 cent per kilowatt-hour and a fuel charge at the rate of 1¼ mills per kilowatt-hour for each dollar or fraction thereof in excess of $5 per long-ton coal cost at the plant of the Cambridge (Mass.) Electric Light Company were authorized to be added to the maximum net price of 9 cents per kilowatt-hour to domestic and commercial lighting customers by a decision of the Massachusetts Department of Public Utilities recently handed down. The above surcharge and fuel adjustment charge are permitted from Jan. 1 to June 30, 1921, inclusive, unless otherwise ordered. The company sought to increase its maximum net rate from 9 to 12 cents per kilowatt-hour, but this advance was opposed by the city of Cambridge on the ground that costs are receding and that in view of the company's past prosperity and improving prospects no change in maximum rate is necessary. The commission felt that some relief should be granted, as the company's net earnings since July 1, 1920, have been sufficient to meet operating expenses and interest charges only. The board held that customers paying the maximum price should, like other classes, share in the surcharge and fuel clause. At the hearing W. E. Holmes, general manager, pointed out that the cost of coal to the company was $12.07 per ton against about $4.50 in 1914.

Super-Power Transmission Survey for Northwest

A SUPER-POWER transmission survey for the Northwest is to be made by a special commission appointed by the American Association of Engineers. To select a committee to investigate the project and draft plans for it the following committee has already been appointed: J. C. Stevens, F. D. Weber, D. C. Henny, W. H. Cullers, Paul Lebenbaum, F. F. Henshaw, Percy A. Cupper, E. R. Cunningham, R. W. Barnes, O. Laurgaard, Thomas Pumphrey, R. H. Dearborn, William S. Turner and L. T. Merwin.

The plans also involve a survey, it is reported, of the available power on the Cowlitz, Clockamas and Deschutes rivers.

Providence Utility Waives Right to Increase Rate Under Fuel Clause

ALTHOUGH the Narragansett Electric Lighting Company of Providence, R. I., under an agreement made with the city in December, 1917, is entitled to increase its rates for service to domestic and other small consumers one-half cent per kilowatt-hour for the next six months, the company appeared before the Public Utilities Commission on Dec. 31 and asked permission to waive, temporarily at least, this right, which was granted.

Under a fuel clause that made the cost of $8 per long ton of coal of 14,500 B.t.u. the basis, it was agreed that for every decrease or increase of $5 or fractional part thereof greater than one-half in the cost of coal there should be a corresponding change in rates of 5 mills for each kilowatt-hour sold. Any such change to be effective for six months subsequent to the six months' period over which the cost of coal was computed. The price of coal to the company has averaged more than $10.50 for the past six months, and under the agreement the company would be entitled to an increase of one-half cent per kilowatt-hour for the next six months.

Instead of exercising its right to advance the rates accordingly at this time the company will file with the commission a revision of its present fuel clause under the existing rate, which will probably result in no advance being made to small consumers, but will secure

the company against any loss through some future arrangement.

This could be done by making provision that when the price of coal drops later on so low that a corresponding drop of a cent or more per kilowatt-hour in the price of electricity would be necessary allowance could be then made for the loss the company might temporarily incur by failing to take its present one-half cent increase.

Consulting Engineers to Consider Joining Federation at Annual Meeting

ON MONDAY evening, Jan. 17, the American Institute of Consulting Engineers will hold its annual meeting at the Engineers' Club, New York, at which time the ballots for vacancies occurring in the council will be counted and reports of officers and committees will be read. The report of a special committee appointed to investigate the advisability of the Institute's joining the Federated American Engineering Societies will be presented and discussed. The topic for general discussion will be "Engineering, Past and Future." An informal dinner at 6:30 p.m. will precede the meeting.

Growth of Customer Ownership in Byllesby Securities

LAST year's experience in selling securities of companies controlled by the Byllesby Engineering & Management Corporation to local customers affords a good indication of the rapid growth of this plan. O. E. Osthoff, vice-president of the Byllesby company, made this statement to a representative of the ELECTRICAL WORLD a few days ago, asserting that the aggregate of such sales for 1920 has been $6,200,000 par value, an increase of 83 per cent over 1919. The total for all the Byllesby companies since the beginning of the movement in 1915 has been upward of $14,500,000. The sales for 1919 were $3,388,100. Taken with 1920, the two years cover two-thirds of the total, while 1920 covers nearly half. This growth indicates clearly, Mr. Osthoff said, the position that the movement is taking in the utility field.

Retiring Illinois Governor Comes Out Against Commission Abandonment

ABANDONMENT of the Public Utility Commission at this time would leave in effect for an indefinite period schedules that were for the most part fixed at the peak of prices, retiring Governor Lowden of Illinois asserted in his farewell message presented to the first session of the Legislature on Wednesday.

"During practically the entire period of its existence, since Jan. 1, 1914" Governor Lowden said, "the commission has been compelled to solve not only the usual problems which concern an enterprise newly created but also extraordinary problems of an ever-changing character. The effect of the war in its relation to public utilities was not seriously felt during the first few months that it raged. The commission was called upon in many instances, particularly after the declaration of war by the United States, to increase the rates charged for the service rendered by the public utilities, if they were to continue to function efficiently in the performance of their duties to the public. Contrary to all expectations, the cessation of hostilities in November, 1918, did not retard the advance in prices, but they continued to increase until a very recent period. There are now many indications that the peak in prices has been reached, and that in the absence of unusual disturbances they will gradually approach the level of prices obtaining prior to the war. Should this prediction prove to be correct, we may reasonably expect that so far as rates are concerned the time of the commission will be as fully occupied in the near future in passing upon applications for the reduction of rates as in the last two years it has been in hearing applications for increases.

"Were the power to regulate rates by commission abandoned at this time," Governor Lowden declared, "schedules would be left in effect for an indefinite period which for the most part were fixed at a time when the peak in the prices of labor, materials and supplies entering into the cost of production was reached."

Recommends New Jersey Law for Right to Make Service Extension Rules

AN UNUSUALLY large number of complaints were received last year by the New Jersey Board of Public Utility Commissioners, it is stated in the annual report issued a few days ago, because of the refusal of utilities to extend facilities and supply service on application.

These complaints, it was stated, resulted from the utilities' policy of refusing to make service extensions unless the prospective customer agreed to pay the cost therefor. The board recommends that the law be changed so that it may after a hearing fix just and reasonable rules and regulations to be observed and followed by utilities in making extensions.

Daylight Saving Again Before New York Legislature

ANOTHER effort will be made at this session of the New York State Legislature to kill state-wide daylight saving. One measure would repeal daylight saving entirely, while another measure would provide for local option thereon.

The state seems rather clearly divided on this subject between the large cities and the rural districts. The Merchants' Association of New York City is actively engaged in an effort to procure daylight saving not only for New York but for the entire eastern district of the country.

Contractors' Executive Committee to Meet

THE annual meeting of the executive committee of the National Association of Electrical Contractors and Dealers will be held on Jan. 24 and 25. In addition to the appointment of committee chairman and the customary business there will be a further report on the investigation into overhead and its relation to the selling price. The first report was made at the annual convention this fall at Baltimore, and at that time the work of circularizing the manufacturers and jobbers on this topic was authorized. It is the results of this survey that will be presented to the executive committee meeting.

The association's special representative, L. W. Davis, has just returned from a two months' trip in the Middle West, where more than fifty new members were secured. He is now starting on an extended tour of the Far West, returning through the South in March.

One Commission for Electric Utilities Contemplated for New York State

CONCENTRATION of regulatory power over all electric light and power companies and gas companies in New York State in the hands of one commission is contemplated by Governor Miller, according to information made public this week. New York now has two commissions. The up-state or Second District commission has jurisdiction over all utilities except those of New York City, which comes under the First District Commission.

It is Governor Miller's present intention to ask the State Legislature for a law confining the activities of the First District Commission entirely to New York City traction lines. In that event the other New York City utilities will come under the supervision of the up-state commission, which has its headquarters at Albany.

This contemplated action is in line with the announced economy plan of the new state administration, which feels that the up-state commission is well equipped to handle the gas and electricity regulation for the entire state without division of authority as prevails under the present arrangement.

Power in the Rubber Industry, Topic of January A. I. E. E. Meeting

A MEETING of the American Institute of Electrical Engineers is scheduled for Jan. 14 at the Akron (Ohio) Engineering Society rooms, under the industrial and domestic power committee and the Cleveland and Akron Sections of the Institute, the topic of the technical session being "Application of Electric Power in the Rubber Industry."

The morning will be taken up with the meetings of the board of directors and committees, and the afternoon will be devoted to an inspection trip through the B. F. Goodrich plant.

Federal Power Commission Appropriation Cut to $100,000

INSTEAD of the $482,065 requested by the Federal Power Commission for its expenditures for the next fiscal year, the committee on appropriations allowed only $100,000. The item, as reported by the committee, has been approved by the House of Representatives, but an effort will be made to increase it when the bill reaches the Senate.

It is hoped that in the meantime the water-power act can be amended so as to allow the commission to expend this appropriation directly for salaries. Hearings on the Esch amendment to the act began Jan. 5. If the amendment is not passed before the sundry civil bill becomes a law a deficiency appropriation will be asked.

Unless additional funds are made available, Secretary Merrill has advised the appropriations committee, it will take four years to dispose of the water-power applications now before the commission. He points out that the commission is required to pass on every project with due consideration of the plans, the design and the relation of the scheme to other projects and to the general plan for developing the stream concerned for navigation, irrigation or power.

To make it absolutely sure that water-power leases shall not be allowed in national parks, the House of Representatives has approved a proviso that none of the appropriations allowed the commission for the coming fiscal year is to be expended in connection with any application which affects a national park.

A. I. E. E. Midwinter Convention Will Include Six Technical Sessions

THE seventh midwinter convention of the American Institute of Electrical Engineers, which will be held in New York City, Feb. 16-18, in the United Engineering Societies Building, 33 West Thirty-ninth Street, will include six technical sessions, visits to various power plants, a dinner dance and the Edison medal presentation, followed by a lecture. On Wednesday, Feb. 16, the morning will be devoted to registration and to arrangements for the visits to the power plants, which will be made on Wednesday afternoon. In the evening there will be a technical session. Thursday morning and afternoon will be occupied by technical sessions, and in the evening the usual dinner dance will be held at the Hotel Astor. There will be technical sessions on Friday morning and afternoon, and on Friday evening the Edison medal will be presented to Dr. M. I. Pupin. The subject of the semi-popular lecture on recent advances in science which will follow this presentation will be announced later.

The tentative technical program of the convention is as follows:

WEDNESDAY, FEB. 16

Evening.—Opening address by President A. W. Berresford; symposium of questionnaire on oil circuit breakers for the protective devices committee, by H. R. Woodrow; "Tests on Oil Circuit Breakers," by P. Torchio. (Moving pictures and oscillograph records of switches, at the instant of failure.)

THURSDAY, FEB. 17

Morning.—Sub-committee on wires and cables, standards committee: "Permissible Operating Temperatures of Impregnated Paper Insulation in Which the Dielectric Stress is Low," by W. A. Del Mar, chairman.

Afternoon.—Telephone and telegraph committee, D. McNicoll, chairman: "Multiple Use of Wires," by S. Rhoads; "Carrier-Wave Telephony," by F. B. Jewett and B. Gherardi.

FRIDAY, FEB. 18

Morning.—Instruments and measurements committee, F. V. Magalhaes, chairman: "A New Design of Current Transformer," by H. B. Brooks and F. C. Holtz; "Regulation of Frequency for Purposes of Measurements," by P. H. Smith; "A New Type of Differential Voltmeter," by E. D. Doyle; "Variation of Eddy Currents in Conductors of Different Stranding," by J. A. Cooke; "Mechanical Wave Analyses," by F. S. Dellenbaugh; "Stop Watches," by A. L. Ellis.

Afternoon.—Miscellaneous session: "Short-Circuit Current of Induction Motors and Generators," by R. E. Doherty and E. T. Williamson; "Hysteresis Phenomena with Superimposed Frequencies," by W. Fondiller; "The Longitudinal Flow of Heat in the Windings of Electrical Machinery," by C. J. Fechheimer.

Electric Light and Power Refunding in 1921 to Be Almost $100,000,000

A COMPILATION made by Dow, Jones & Company gives $305,110,350 as the total for all public utility bond and note issues maturing in 1921. From that compilation the ELECTRICAL WORLD has selected all of the issues amounting to $200,000 or more of electric light and power companies, as listed below. The sum of these selected issues, all of which is not necessary for electrical business, as a number of the companies are combination properties and there is no way of telling now for which branch the money was expended, shows that a little less than a third of the grand total, or $97,504,800, is the amount of securities that the electric light and power companies will have to refund in one way or another during 1921. The largest of these is $14,601,000 in three-year notes of the Puget Sound Traction, Light & Power Company, which falls due June 1. There are only six other issues for more than $3,000,000, the largest of which are $10,000,000 in two-year notes of the Toledo Traction, Light & Power Company, due Dec. 1; $8,254,700 in notes of the Consolidated Gas, Electric Light & Power Company of Baltimore, due Nov. 15, and $7,500,000 in one-year notes of the United Gas Improvement Company to be paid Feb. 1. June has the largest monthly total, $15,351,000, followed by November and December, with $14,426,700 and $14,143,100 respectively.

Due	Corporation	Type of Security	Rate	Amount
Jan. 1	East St. Louis & Suburban Co.	Convertible	7	$2,116,000
Jan. 1	American Gas & Elec. Co.	Notes	6	1,500,000
Jan. 1	Little Rock Ry. & Elec. Co.	One-year notes	7	1,000,000
Jan. 1	Middle West Utilities Co.	Series D notes	6	1,000,000
Jan. 1	Pueblo Trac. & Lighting Co.	First mortgage	5	990,000
Jan. 1	Dallas Electric Co.	Five-year notes	6	750,000
Jan. 1	Pensacola Electric Co.	Two-year notes	7	500,000
Jan. 1	Toledo Heat & Lighting Co.	First mortgage	5	336,000
Jan. 1	Decatur Trac. & Electric Co.	First mortgage	5	212,000
Jan. 15	Southern California Edison Co	Debentures	7	1,000,000
Total for January				$9,404,000
Feb. 1	United Gas Improvement Co.	One-year notes	6	$7,500,000
Feb. 1	Newburgh Lt., Ht. & Pwr. Co	First mortgage	5	700,000
Feb. 1	Wisconsin-Minnesota Light & Power Co.	One-year notes	7	600,000
Feb. 1	Georgia-Alabama Power Co.	Two-year bonds	7	525,000
Feb. 1	Greenfield El. Lt. & Pwr. Co.	Three-year notes	7	300,000
Feb. 1	Connecticut Company	Provisional deb.	5	250,000
Total for February				$9,875,000
Mar. 1	Oklahoma Gas & Electric Co.	One-year notes	7	$3,500,000
Mar. 1	American Gas & Electric Co.	Three-year notes	6	1,390,000
Mar. 1	Pub. Service Co. of No. Illinois	Debentures	6	1,000,000
Mar. 1	Merchants' Heat & Light Co.	One-year notes	7	600,000
Mar. 1	Consolidated Power Co.	Three-year notes	6	468,000
Mar. 1	Richmond Lt., Ht. & Pwr. Co.	Two-year notes	7	440,000
Mar. 1	Commonwealth Pub. Serv. Co.	Two-year notes	6	300,000
Mar. 1	Dayton Electric Light Co.	First mortgage	5	265,000
Total for March				$7,963,000
Apr. 1	Birmingham Ry., Lt. & P. Co.	Extension notes	6	$1,200,000
Apr. 1	Manchester Tr., Lt. & P. Co.	First mortgage	5	914,000
Apr. 1	Everett Ry. & Electric Co.	First mortgage	5	825,000
Apr. 1	Portland Light & Power Co.	First mortgage	4½	500,000
Apr. 1	Fox River Valley Gas & El. Co.	First mortgage	5	350,000
Total for April				$3,789,000
May 1	Lacombe Electric Co.	First mortgage	5	$900,000
May 1	Missouri Elec. Lt. & Pwr. Co.	Second mortgage	6	600,000
May 1	Columbus, Delaware & Marion R.R.	First mortgage	5	289,000
May 15	Monongahela Valley Trac. Co.	One-year notes	7	2,000,000
Total for May				$3,789,000
June 1	Puget Sound Tr., Lt. & P. Co	Three-year notes	7	$14,601,000
June 1	Chattanooga Ry. & Light Co.	One-year notes	6	750,000
Total for June				$15,351,000
July 1	Ontario Power Co. of Niagara Falls	Debentures	6	$2,770,000
July 1	Consolidated Ry. & Pwr. Co.	First mortgage	5	1,401,000
July 1	Sioux City Gas & Elec. Co.	First mortgage	5	1,000,000
July 1	Rochester Gas & Electric Co.	Improvement	4½	700,000
July 1	Ohio Utilities—Ohio W. Util.	Joint issue	7	650,000
July 1	Wisconsin Pwr., Lt. & Ht. Co.	Three-year notes	7	200,000
July 5	Virginia Railway & Power Co.	Notes	6	200,000
Total for July				$6,921,000
Aug. 1	American Power & Light Co.	Ten-year notes	6	$2,200,000
Aug. 1	Derby Gas Co.	First mortgage	4	250,000
Aug. 15	Iowa Railway & Light Co.	Two-year notes	6	731,500
Total for August				$3,181,500
Sebt. 1	Rochester Ry. & Light Co.	Three-year general mortgage	7	$3,900,000
Sept. 1	Aurora, Elgin & Chicago Co.	Three-year notes	7½	1,219,000
Sept. 1	Middle West Utilities Co.	Series E notes	6	800,000
Sept. 1	Standard Gas & Electric Co.	Three-year notes	7	710,000
Sept. 1	So. Carolina Lt., P. & Ry. Co.	Notes	7	650,000
Sept. 1	Oklahoma Gas & Elec. Co.	Three-year notes	7	332,500
Total for September				$7,611,500
Oct. 15	Hagerstown & Frederick Ry.	One-year notes	8	$1,050,000
Nov. 1	Trumbull Public Service	Notes	7	$1,200,000
Nov. 3	Edison Light & Power Co.	First mortgage	6	623,000
Nov. 15	Consolidated Gas, Elec. Light & Power Co., Baltimore	Notes	5	8,254,700
Nov. 15	Standard Gas & Electric Co.	Two-year notes	7	4,349,000
Total for November				14,426,700
Dec. 1	Toledo Trac., Lt. & Pwr. Co.	Two-year notes	7	$10,000,00
Dec. 1	American Gas & Electric Co.	Two-year notes	6	2,479,000
Dec. 1	Connecticut Power Co.	Two-year notes	6	681,100
Dec. 1	Portland Ry., Lt. & Pwr. Co.	Notes	7	500,000
Dec. 1	Citizens' Gas & Electric Co.	First mortgage	5	483,000
Total for December				$14,143,100

Electric light and power utility bonds and notes maturing in:

January	$9,404,000	July	$6,921,000
February	9,875,000	August	3,181,500
March	7,963,000	September	7,611,500
April	3,789,000	October	1,050,000
May	3,789,000	November	14,426,700
June	15,351,000	December	14,143,100

Total for 1921 ..... $97,504,800

Southern California Edison Not to Delay Construction Program

BELIEVING that present unsettled conditions should not delay the construction of additional hydro-electric generating plants or extensions to the existing transmission and distribution systems of the company, the officials of the Southern California Edison Company are proceeding actively with a fifteen-year construction program which calls for the production and distribution of nearly $200,000,000.

"We have found that there has been no slackening of the demand for power to expand industries and develop additional agricultural lands," R. H. Ballard, vice-president and general manager of the company, said to an ELECTRICAL WORLD representative recently, "and we anticipate an increased growth not only for this year but for many years to come. California has been dependent upon electrical service for many years, and as a result of the war and other conditions which have stimulated the growth not only of California but of the whole Pacific Coast we feel that it is the first duty of the electric utilities to go ahead with their developments. The tremendous increase in population on the Pacific Coast during the past decade and the favorable climatic conditions, which permit of high labor output, have brought about demands for power greatly in excess of the available supply. An additional reason for the future development of hydro-electric power is that the company has been operating steam plants at a higher cost than will result from hydro-electric plants.

"Although the unit cost of developments made at this time will be above normal, yet it is anticipated that, as prices are already declining, only a small portion of these developments will be made at the present higher cost, and this increased cost will be more than offset by increased economy of operation. The general plan of financing is to issue bonds to the extent of 75 per cent of the cost for general distribution to investors throughout the country and to sell stock locally to finance the remainder."

Water Power League to Hold First Annual Meeting Jan. 18

THE Water Power League of America will hold its first annual meeting in the Engineering Societies Building in New York on Jan. 18 for the election of officers for the ensuing year. After the regular business has been transacted the meeting will be thrown open to a general discussion of the power situation, both steam and hydro-electric. It is expected that there will also be considerable discussion of recent propaganda concerning the national park reservations.

Metric System Bill Introduced Into Senate

A BILL providing for the compulsory use of the metric system as the single standard of weights and measures in the United States has been introduced into the Senate by Senator Frelinghuysen of New Jersey. The bill was introduced at the request of advocates of the metric system. Senator Frelinghuysen explains that the introduction of the bill by him does not necessarily carry with it any support for the measure on his part, but he sees no reason why it should not be introduced so that members of Congress may acquaint themselves with its purport.

Failure to Appropriate Funds to Continue Muscle Shoals Work Causes Storm

FAILURE on the part of the appropriations committee of the House of Representatives to provide funds for continuing work on the Wilson Dam at Muscle Shoals precipitated an acrimonious debate on the floor of the House on Dec. 30 and 31. An effort was made to put in an item of $10,000,000 for this project over the protest of the committee, but this failed. It is felt there is a better chance for securing its inclusion in the measure when it reaches the Senate. Prospects are that the matter will be the cause of one of the most spectacular legislative clashes that have taken place in years.

Those favoring the continuance of work on the Wilson Dam contend that the government has invested more than $100,000,000 in a project whose primary purpose concerns the national defence in making the country independent of outside sources for its supplies of nitrogen. A large plant is ready for operation, but cannot be operated economically until the development of the water power at Muscle Shoals. It is contended that the only way in which the nation can keep abreast with other countries in the matter of nitrogen fixation is for the government to operate this plant on a commercial scale during peace times.

The attitude of the committee is based largely on the need for retrenchment in government expenditures, although it is also openly charged that the Muscle Shoals plan is socialistic and would be an unjustifiable encroachment upon private enterprise. There are many ramifications of the discussion. Charges are made of gross inefficiency in the use of the money thus far appropriated for this project, while the matter of patents and the processes of nitrogen fixation are also involved. It was brought out that Col. Hugh L. Cooper, who is acting as a consulting engineer at the Wilson Dam, is contributing his services without charge. It was stated that he estimates that failure to make an appropriation for the continuance of the work would result in a loss to the government of $4,000,000. A statement by Colonel Cooper as to the power which will be developed if the dam is completed was made a part of the record. It was that the primary power per annum which could be developed is 700,000,000 kw.-hr. The secondary power per annum would be 1,470,000,000 kw.-hr.

At one point in the debate Representative Bankhead said: "Do you know that we are today standing barely upon the threshold of scientific investigations of electrical energy? It would be to the interest of the country if, for experimental purposes alone, the government had such a plant for the purpose of continuing these scientific experimentations in the great domain of electric chemistry into which we are just entering."

Rocky Mountain Electrical League Selects Emblem

THIS is the emblem selected from twenty-five in the prize contest to be featured by the Rocky Mountain Electrical Co-operative League on all officials, stationery and in all league advertising.

Engineering Council Activities Transferred to Federation

TRANSFER of the activities of the Engineering Council and the Engineering Societies Service (employment) Bureau was made this week to the American Engineering Council of the Federated American Engineering Societies. The American Engineering Council now has an office in Washington, D. C., at the McLachlen Building, Tenth and G Streets, with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies.

The Engineering Societies Service Bureau is being maintained in the Engineering Societies Building, New York City, with Walter V. Brown in charge. Pending the development of a more permanent organization which may direct this activity, the secretaries of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a committee on management to conduct the service bureau. The committee on procedure of the executive board of the American Engineer-

ing Council, voting to take over the employment service, specified that the applicants should be arranged in two groups—first, those who are members of member societies of the Federated American Engineering Societies, and, second, all others. As a means of communicating with the secretaries of the member societies of the Federated American Engineering Societies, a bulletin listing positions open will be regularly issued. The first of these bulletins will be sent very soon.

The following committees of the former Engineering Council have been invited to act as committees of the American Engineering Council: Classification and compensation of engineers; co-operation with American Institute of Architects; National Board for Jurisdictional Awards in Building Industry; National Service Department; New York State government reorganization; patents committee; payment for estimating; Russian-American committee; types of government contracts.

Berlin Factories on Energy Rations

SINCE Nov. 15 an electrical energy rationing plan has been in force for all industrial plants in Berlin, Germany, consuming more than 250 kw.-hr. per month. No works supplied by the Berlin municipal power plants are permitted to use energy during the morning hours from 6 to 10 o'clock for other than lighting purposes unless they are working in shifts. This refers to plants using up to 1,000 kw.-hr. per month. All plants whose consumption is in excess of this figure must, if working three shifts, take 35 per cent of their total energy during night hours, that is, from 10 p.m. to 6 a.m.; otherwise they have to take an even 50 per cent of the energy during these hours. All works not connected to the municipal plants are allowed only 80 per cent of the total energy consumed during the period of Jan. 1 - Sept. 30, unless they are prepared to take 35 per cent of the energy during night hours.

These new measures have largely been dictated from economical considerations, because the coal supply of the Berlin power houses is largely of the hand-to-mouth order, while the long-distance energy obtained from Golpa—the big central station near Halle, using lignite firing—has not been properly utilized up to now. The practical result of the new order is the establishment of night shifts by most of the Berlin works, although some of the largest industrial firms, possessing power plants of their own, are not affected by the regulation.

Ontario Engineers Prepare Bill for Professional Recognition

AN ADVISORY committee appointed last winter by seven technical organizations in the Province of Ontario to discuss the subject of engineering legislation for that province has presented a report embodying a bill which follows closely the lines of acts now in force in nearly all the other provinces of the Dominion. As its main feature the control of engineering is placed in the hands of the profession itself, thereby avoiding control by government officials who may lack full understanding of the requirements. The provincial government, however, will have a share in choosing the personnel of the council which is to be created, thus providing a guarantee that the council cannot be controlled by any particular group. The different branches of engineering—not including the architects, whose association held that its interests would be better served by independent legislation—are given equal representation, so that no one branch can gain control. The branches are made partly autonomous, with power vested in the council to prevent too wide variations. Engineering only is intended to be covered by the legislation. Technical trades and similar occupations cannot be brought within its scope. Only by remaining distinct from these, it is held, can engineers attain full professional status. Provisions for the registration of those now practicing as engineers are, however, made reasonably broad, so that no fairly qualified individual can be debarred from his present pursuit of livelihood.

Harriman Tells What St. Lawrence Power Means to New England

BEFORE a recent meeting of the Boston Society of Civil Engineers, in discussing a paper on New England water-power resources by H. K. Barrows, a consulting engineer of Boston, Harry I. Harriman, president of the New England Power Company of the same city, commented upon the possibilities of the St. Lawrence River hydro-electric project and outlined additional phases of the proposed development. The speaker said that in the St. Lawrence 240,000 cu.ft. of water drop 221 ft. per second. Four or five dams would be built with effective operating heads of 35 ft. to 60 ft. On the St. Lawrence the maximum flow varies less than 25 per cent from the mean, owing to the 9,000-square-mile drainage area of Lake Ontario. The storage of this lake is so vast that it can be utilized to produce energy to equalize the low season of many New England and New York water powers and to supply the peak load of the winter months. If New England were to get behind the project, it would be entitled to about 6,500,000,000 kw.-hr. from the river plants, or say to 6,000,000,000 kw.-hr. at local substations.

In 1919 the railroads of New England used about 6,000,000 tons of coal on their 5,000 miles of track. Eighty per cent of this was consumed on less than 1,500 miles of track. The speaker said that $25,000 per mile should cover the track structures and substations, making about $40,000,000 to electrify the 1,500 miles which burn most of the coal in that section. Electric locomotives will add another $40,000,000, but in so far as these are used to replace obsolete steam locomotives their cost should not be charged to capital. Further, electrification probably will not proceed more rapidly than the steam equipment wears out. Accordingly, Mr. Harriman said, it seems fair to assume that the electrification of the main lines of the New England railroads will not cost more than $50,000,000.

The coal now burned by the New England main lines per year could be replaced by about 1,800,000,000 kw.-hr. from the St. Lawrence, costing about $18,000,000 and yielding a saving of from $20,000,000 to $30,000,000 for fuel outlay. The cost of electrification will be covered in a very few years of full operation. After that the New England roads will obtain their power on as favorable a basis as roads passing through the coal regions.

The electric utilities of New England generate about 2,000,000,000 kw.-hr. a year, of which more than 75 per cent is produced in steam plants. The present combined use of the railroads and utilities of the section is less than 3,500,000,000 kw.-hr., leaving 2,500,000,000 if the St. Lawrence supplies all of the energy.

There are about 18,500,000 cotton spindles in New England, and, allowing twenty-two spindles per horsepower, it is estimated that on the basis of a forty-eight-hour week these mills use something less than 1,400,000,000 kw.-hr. yearly. At least 25 per cent of these spindles are driven mechanically by water and therefore 1,000,000,000 kw.-hr. would replace all of the coal-produced energy in these cotton mills.

In New England there are about 2,100,000 woolen spindles with 4,200 cards. These spindles require about 200,000 hp. Much heat is needed in process work. Not over half the power required by the woolen mills can be supplied by the central station; hence about 175,000,000 kw.-hr. would be required by the woolen mills. The paper mills would use about 200,000,000 kw.-hr. from the St. Lawrence. The boot and shoe factories, wire and rubber-goods plants and brass establishments might utilize 100,000,000 kw.-hr. It is doubtful if the present industries of New England would use over 2,000,000,000 kw.-hr., and there would be a surplus of 500,000,000 if the railroads used 2,000,000,000 and the utilities 1,500,000,000. Enough is known, said the speaker, to assure that power can be delivered to the New England states in wholesale blocks from the St. Lawrence for less than 1 cent per kilowatt-hour.

British Government's 500,000-Hp. Tidal Scheme for the Severn

MORE details of the 500,000-hp. tidal-hydro-electric scheme fathered by the British Ministry of Transport and first reported by cable several weeks ago are contained in a recent issue of the London *Electrician*. This ambitious plan, which aims at the production of 500,000 hp. in a ten-hour day, with a peak load of 1,000,000 hp., at an estimated cost of a little more than 1 cent per kilowatt-hour, is based on the construction of a dam across the Severn River and the utilization of the tidal power. With the project are linked in plans for extensive highway and railway development and for a locked basin for shipping purposes, 27 square miles in extent, a very large portion of which would, it is held, be suitable for the accommodation of vessels of the largest size and which would be usable at all stages of the tide.

There would be two separate installations required, a great concrete dam across the Severn, within which sluices and turbines would be installed for utilizing the power of the tides and with which would be combined a road bridge and a railway bridge, and a high-level storage lake and tunnel with a pumping and turbine house on the banks of the tidal portion of the Wye River, which empties into the Severn. It is proposed that water be forced up from the low level of the Wye through a 40-ft. tunnel driven through more than a mile of solid rock. The sea water would be pumped into high-level reservoirs during the rising tide, and this stored water would be used to supply the turbines at ebbing tide. The site which has been selected for the barrage lies close to the line of the existing railway tunnel between south England and south Wales at a place where the estuary is about 2½ miles wide with low-lying country on each side.

It is held that the power available on the Severn exceeds all the other potential sources of inland water power within the United Kingdom and is also unique in combining all the conditions essential to the economic development of tidal water power on a large scale. These conditions present an exceptionally high range of tide, an estuary of large capacity, an ideal geographical situation in relation to the industrial centers of the country, and suitable land along the banks of the river for the development of industrial operations. The capital cost of the scheme is not explicitly stated, but the *Electrician* understands that £30,000,000 is about the figure, exclusive of expenditure for transmission lines.

In common with other English engineering and electrical papers, the *Electrician* thinks that its great cost removes the project from the category of immediate expediency. A later and independent report on the project by the Board of Trade puts the estimated output at only 260,000 hp.

Utah Power & Light Would Further Develop Bear River

THE projects for which preliminary permits are asked by the Utah Power & Light Company are intended to supplement the present development on the Bear River. Permits have been asked to develop 21,500 hp. at Soda Springs, Lava Narrows and Mink River, the latter possibly being divided into two plants for public utility purposes.

This company is at present producing about 100,000 hp. on the Bear River in the Grace, Cove, Oneida and Wheelon plants. The head at the Grace plant alone is 525 ft. The projects now under application include a head of 85 ft. at Soda Springs, a similar head at Lava Narrows, and a head of 100 ft. in either one or two plants at Mink River. This gives a total head of 270 ft.

The importance of the plants to the complete Bear River system does not so much lie in the power developed as in the fact that at each of these plants there is contemplated a small reservoir which, in conjunction with the Bear Lake reservoir, will greatly add to the reliability of the system as a whole, making possible more accurate regulation of the flow of Bear River.

Adaptability of Modern Lighting Fixtures to Classic Architecture

In the famous municipal group of buildings at Springfield, Mass., the adaptability of modern electric-lighting fixtures to classic architecture is clearly indicated.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electric Ship Shows Marked Economies.—According to a telegram received at the office of the United American Lines the electrically driven ship *Eclipse*, operated by the United American Lines for the United States Shipping Board, is making a highly satisfactory performance on her maiden voyage since her conversion. The *Eclipse* left New York Nov. 11 for the Levant. She was the first electrically driven general cargo boat to sail from that port. The telegram says that the *Eclipse* arrived at Port Said Dec. 2, with machinery working efficiently. The new installation shows a considerable reduction in fuel and a satisfactory increase in speed.

Radio Messages Now Reach Offices Over Telephone Lines.—By the use of the telephone lines radio messages from overseas can now be automatically relayed to offices in any part of this country without going through the hands of the operators at the wireless receiving station. Development and experimental work carried on by the Radio Corporation of America will soon reach the point where transatlantic messages will be automatically transmitted from the receiving station to inland cities. Inasmuch as the line must be absolutely clear, special telephone wires will be reserved for this service. In a short time, according to an official of the Radio Corporation, an operator will be able to tap a telegraph key at Seattle and his message will be relayed to the wireless station at New Brunswick, N. J., and thence across the Atlantic to Europe. An amplifier is used at the receiving end to make the sounds as clear as possible.

Manitoba's Water-Power Resources.—Addressing the Manitoba Electric Association recently, J. M. Leamy, the power commissioner of the province, said that while Manitoba has great agricultural and mineral possibilities, in his opinion its power resources would figure as much in its development as anything else. There are nine power sites on the Winnipeg River. Two of these are now being developed and can produce 381,000 hp. Six of the other sites are in Manitoba, the ninth being across the border in Ontario. In other portions of Manitoba there is 100,000 hp. available from streams tributary to Lake Winnipeg, including the Saskatchewan River. The Nelson River, which is the outlet of Lake Winnipeg into Hudson's Bay, is estimated to afford 2,000,000 hp. This makes a total possible hydro-electric output of more than 2,600,000 hp. for the province, or, according to Mr. Leamy, eighteen times the amount of horsepower per capita that the United States, including all sections, has.

Lenin Still Dreams of Soviet-Controlled Electrification.—A press dispatch from Moscow says that Nikolai Lenin, the Bolshevist Premier, addressing the All-Russia Congress of Soviets, dealt in detail with measures for the economic restoration of the country. He declared that the restoration of transportation and of agricultural and industrial production was only possible if the government's program for electrification was realized, "An electrification plan," said Lenin, "has been elaborated, the financial cost of which is estimated at 1,500,000,000 gold rubles. We cannot cover this with the gold at our disposal, and we have no great stocks of provisions for sale. Therefore we must provide the cost of electrification by concessions to foreign capital and exports of timber."

The "Franklin" Substation of the Philadelphia Electric.—The latest substation to be put into operation by the Philadelphia Electric Company, at 52 North Sixth Street, has been christened the Franklin substation in honor of Benjamin Franklin. Construction work on this building was started last April, and the first rotary converter, rated at 1,500 kw., was started up seven months later. Two additional machines are to be installed this winter—one of 2,295 kw., the other of 3,315 kw. The latter will be the largest converter on the system. Eventually the substation will house five units with a total rating of nearly 16,000 kw. Only half of the structure has thus far been erected, but its early completion is promised. Energy for the substation is received at 13,200 volts from either the Schuylkill or the new Delaware power house, as desired, by looping in the tie feeders between these stations.

Protecting Electrical Plants Against Attack.—The alleged capture of a document purported to contain a carefully worked-out scheme for the destruction of the municipal power station of Manchester, England, by politically disaffected persons with engineering knowledge leads to a novel proposition from a London contemporary, the *Electrician*, designed to safeguard such plants, not against mobs, assaults by which would obviously be easily repelled, but against insidious methods of attack on the part of men with an understanding of switches and busbars whose object would be first to stop the plant and then to damage the machinery so that it could not be used. "Against such an attack," the *Electrician* says, "the only defence is a prevention of entry except to those who have real business within, admission only through small, well-protected entrances that can be closed by electrically operated portcullises if necessary, and the surrounding of the whole of the power-station area with such protection as would render unauthorized ingress difficult if not impossible."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Wisconsin Electrical Association.—The 1921 convention of the Wisconsin Electrical Association will be held jointly with the Gas Association on March 22, 23 and 24 next at Milwaukee. The gas program will take up the 22d, the 23d will be a joint session, and the Electrical Association program will occupy March 24.

Florida Engineering Society.—The regular annual meeting of the Florida Engineering Society will be held at Lakeland, Fla., on Feb. 7 and 8. In addition to technical papers and inspection trips to engineering works in the vicinity, it is expected that action will be taken by the society on matters of interest to engineers to be brought before the State Legislature.

Iowa Engineering Society Annual Meeting.—The annual meeting of the Iowa Engineering Society will be held at the Chamberlain Hotel in Des Moines on Jan. 18, 19 and 20. Every indication points toward a very successful meeting. A feature of the occasion outside of the usual technical and social program will be the manufacturers' exhibits. Special attention is being given to the planning of these exhibits with a view toward making them interesting and profitable. There are now approximately 1,200 registered engineers in the State of Iowa. This, coupled with the fact that the State Legislature meets in Des Moines in January, is arousing much interest in the meeting.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Philadelphia Section, Jan. 8; Cleveland Section, Jan. 10; Chicago Section, Jan. 15; Pittsburgh Section, Jan. 15; Birmingham Section, Jan. 27.

American Institute of Electrical Engineers—Akron-Cleveland, Jan. 14; Portland (Ore.) Section, Jan. 10; Boston Section, Jan. 11; Pittsfield Section, Jan. 20; Chicago Section, Jan. 24.

Iowa Engineering Society — Des Moines, Jan. 18-20.

Wisconsin State Association of Electrical Contractors and Dealers—Milwaukee, Jan. 19 and 20.

American Washing Machine Association—Chicago, Jan. 19 and 20.

American Society of Civil Engineers—New York, Jan. 19.

Western Association of Electrical Inspectors — Detroit, Jan. 25-27. (For program see issue of Jan. 1, page 58.)

Association of Municipal Electrical Utilities of Ontario—Toronto, Jan. 27 and 28.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section) — New York, Jan. 28.

Florida Engineering Society—Lakeland, Fla., Feb. 7 and 8.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see "News of the Industry," this issue.)

American Physical Society — New York, Feb. 25 and 26.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Rate Decisions in Utah.—The Public Utilities Commission of Utah has overruled a protest filed by the town of Milford against the rates of the Telluride Power Company. The company had furnished power to Milford for operating the municipal pumping plant at the rate of $60 a month in winter and $100 in summer during the irrigation season. On Jan. 1, 1920, the Telluride company raised its rate, which was the cause of the protest. The Perry Electric Light & Power Company has received permission to raise its lighting rate from 7 cents to 10 cents a kilowatt-hour. The Perry company buys its power from the town of Brigham City, which has recently been permitted to raise its rates to the Perry plant.

Steam-Heating Rates Advanced.—An order increasing the rate paid to the Union Electric Light & Power Company, St. Louis, for steam heat from an average of 57.6 cents per 1,000 lb. to 81.6 cents has been handed down by the Missouri Public Service Commission. The order affects 106 business firms and office buildings in the downtown district of St. Louis. It will increase the revenue of the company $246,000 a year, which is $65,000 less than asked. The company declared that its steam rates have been unprofitable for several years and that the rates asked contemplated no return on plant investment. It declared that the cost of producing steam last year was $1.10 per 1,000 lb. The users of steam combined to oppose the fixing of a rate by the commission. The rate fixed now supersedes contracts between the individual users and the company.

Rate Differentials as Applied to Domestic Consumers. — In handing down a decision fixing gas rates for the Rochester Gas & Electric Corporation the Public Service Commission for the Second District of New York made these observations on rate differentials as governed by the cost of fuel: "During the late war sudden and extreme fluctuations in the price of coal led to many proposals to establish rates with a standard base and varying upward and downward from that base as the price of coal should rise or fall. This device appealed particularly to large consumers of electric energy, came to be known as the 'coal clause,' and crept into the power rates of many electrical corporations; and such rates are now in effect. Applied to such consumers, generally large consumers, with officials having the information and experience necessary to calculate their expenses with this clause in view, such rates have not been the subject of complaint, and it must be assumed that they have operated equitably and to the satisfaction of the electrical corporations and the consumers as well. Whether they should be applied to the great mass of consumers may not present a different legal question, but certainly presents an entirely different problem as to justice and expediency. Underlying the rate provisions of the Public Service Commissions law is the principle not only that rates shall be reasonable but that they shall be published and to such a degree stable that the consumer may know in advance the price to him of the service to be rendered. This may to some extent be accomplished by the variable rate—that is to say, the period of stability may be such as to give the consumer the price for one, two and three months in advance by basing, for example, the rate for any quarter upon the experience of the corporation for the preceding quarter. This hardly accomplishes the purpose of accommodating rates to rapidly fluctuating costs. By the method suggested the rate for a given quarter would be based not on the actual costs for that quarter but on the costs for the preceding quarter. In the long run the price paid by the consumer would be the average based upon costs in the different periods, but to accomplish this result no such device as that proposed is necessary. All that is desirable in the proposed scheme can be provided by fixing at this time the rate for a definite and short period with the provision that at the end of that period the company may apply at the foot of this order for an increase, or the commission may, of its own motion or on complaint, reopen the inquiry with a view to making a reduction."

California Commission Increases Rate to Municipality.—What is in effect an order increasing the rates for electricity to be charged by the Western States Gas & Electric Company of Stockton by approximately 10 per cent has been issued by the California Railroad Commission. The order was made on a request by the company for a revision of its rate schedules based on increased costs of labor and materials used in the operation of the electric system serving portions of San Joaquin, Sacramento, Eldorado, Amador and Calaveras Counties. The increase in cost to the company of electrical energy brought from the Pacific Gas & Electric Company and the Great Western Power Company and resold amounts to $75,000 a year. The cost of gas and electricity has been increased $52,000 a year by reason of wage increases. The cost of oil has also increased from 75 cents a barrel to $2.30. The new rates ordered provide for an increase in the charge for electricity sold to the city of Stockton as a municipality. If the company elects to give the city a special rate, the loss must be borne by the company and not passed on to the other consumers, the commission declares, a municipality being no more entitled to preferential rates than are other consumers.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Contract Rates and Public Service Commission's Powers in Vermont.—The Supreme Court of Vermont has found, in Rutland Railway, Light & Power Company vs. Burditt Brothers, that, although the rate charged for electricity under an express contract between a public service corporation and one of its customers may be changed during the term of the contract by the Public Service Commission, such a corporation cannot of its own motion and without the consent of its customer or action on the part of the commission increase the contract rate by simply filing a revised schedule of rates with the commission. (111 At. 582.)*

Judicial Department Cannot Change Public Policy as to Utility Rates.—Declaring, in City of New York vs. Bronx Gas & Electric Company, that it has no authority to fix rates, the New York Supreme Court (special term, Bronx County) reiterates that the regulation of gas and electric companies as to their service and rates is vested in the Legislature and not in the judicial branch of the government, and where the policy of the state has been established by the Legislature the court has no authority to change it. An attempt to put into effect a gas rate of $1.75 pending an action to have the statutory rate of $1 declared confiscatory was, however, held by the court to be so excessive and unreasonable as to authorize an injunction *pendente lite.* (184 N. Y. S. 658.)

Maintenance of Power Plant Below Street Level Not Negligence.—In a damage suit brought by the Rainier Heat & Power Company against the city of Seattle the Supreme Court of Washington has determined that the maintenance of a heat and power plant at a level of 30 ft. below the street grades was not contributory negligence precluding the power company from recovering damages caused by the bursting of a water main, since the company had the right to make the excavation and was not required to anticipate danger from such a source. Whether the plaintiff's failure to provide drains required by city ordinances was contributory negligence was held to be a question for the jury, but such failure would not prevent recovery where the flood of water caused by the bursting of the main was so great that no proper drains could have prevented or lessened the damage. (193 Pac. 233.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

A. E. Wishon, whose appointment as general manager of the San Joaquin Light & Power Corporation, Fresno, Cal., took effect Dec. 1, has for several years held the position of assistant general manager, working with his father, A. G. Wishon, who has been general manager of the company since its organization, seventeen years ago and who was recently elected vice-president and managing director. The younger Wishon has virtually grown up with the

A. E. WISHON

electrical industry in the San Joaquin Valley. He started as an operator on Mount Whitney plant No. 1 and worked in different operating capacities before entering the School of Mines, from which he was graduated in 1908. After graduation he devoted a number of years to the study of the application of electrical power in the oil fields of California, and in 1910 he was placed in charge of the southern division of the San Joaquin Light & Power Corporation, which includes the oil fields. In 1912 he was made assistant general manager and transferred to the main office in Fresno. He has been very active in association work on the Pacific Coast, serving as president of the Pacific Coast Section of the N. E. L. A. last year. He is also the originator of the self-interest plan of financing public utility work locally, which he explained in the issues of the ELECTRICAL WORLD of Dec. 13, 1919 (page 1060), and May 1, 1920 (page 997). This program has created considerable interest throughout the West, where Mr. Wishon has been frequently invited to explain the self-interest idea. While visiting the East last spring he talked on this subject at several large gatherings of electrical men.

G. C. Brown, formerly with the Northern Electric Company at Montreal, has been appointed superintendent of manufacturing for the Habirshaw Electric Cable Company, Inc., Yonkers, N. Y.

J. W. Hall, for twenty years associated with the Pacific Gas & Electric Company, San Francisco, has tendered his resignation as local manager. J. H. Fagg, assistant manager of the San Joaquin district, has been appointed to succeed Mr. Hall.

T. H. Ceperley, who for the past twelve years has been chief operating engineer of the power station and substations of the Albany (N. Y.) Southern Railroad, has resigned his position on account of ill health and expects to spend the winter in the South. He will re-enter the electrical field in the spring. Mr. Ceperley was formerly with the Newburgh (N. Y.) Light, Heat & Power Company as chief engineer of the Newburgh plant, and prior to that with the Fonda, Johnstown & Gloversville Railroad in the same capacity.

J. H. Fagg, assistant manager of the San Joaquin district of the Pacific Gas & Electric Company, San Francisco, has been promoted to the position of local manager of the company, to succeed J. W. Hall. He will have charge of San Joaquin County and parts of the adjoining counties, extending from Jackson to Tracy, Byron, Brentwood and the Delta section as far north as Galt. Mr. Fagg has been associated with the Pacific Gas & Electric Company for seventeen years in its district offices at Sacramento, Maryville, Chico and San Francisco.

C. J. Rutland, who was recently appointed safety engineer for the Texas Power & Light Company's system, has been in charge of stores in its Dallas office during the past year. He has worked in various capacities in the departments of the company at Sweetwater, Paris, Bonham, Waco and Dallas and has been selected for his present position on account of a thorough knowledge of the company's activities and his popularity among his fellow workers. Mr. Rutland is now working on a new program of safety which will revive the old-time safety meetings over the entire system, which covers the industrial sections of the state. He succeeds E. B. Featherstone, who resigned as safety engineer some months ago.

H. R. King, who has been identified with the sales engineering division of the Western Electric Company for nearly twenty-two years, has resigned to become general sales manager and member of the board of directors of the M. S. Wright Company, Worcester, Mass., manufacturer of the Pneuvac vacuum cleaner. Mr. King is a graduate of the University of Michigan, class of 1894, and holds the degree of electrical engineer from that institution. Directly after graduation he became chief engineer of the Fisher Electric Company, a manufacturer of direct-connected electrical generating equipment in Detroit. In 1895 he was associated with Gilbert Wilkes in consulting engineering in Detroit, and in 1896 he opened his own engineering offices. In 1897 he went to South America and spent two years in Venezuela

H. R. KING

in special engineering development work. Mr. King's experience with the Western Electric Company dates from February, 1899, when he entered its power apparatus department in Chicago. In 1904 he became chief engineer of power apparatus, in which capacity he guided the development of a complete line of alternating-current generators and motors and many special direct-current generators. In January, 1908, Mr. King entered the sales field as assistant power apparatus sales manager at Hawthorne. Two years later he was transferred to New York as power apparatus sales manager. In this capacity he was largely responsible for the development of the so-called Western Electric specialties—washers, vacuum cleaners, etc. He worked on the theory that it was just as advisable to install motors in the home as in the factory, and the present widespread recognition of motor-driven home appliances is really a monument to his foresight. Last January he was appointed power and light sales manager, filling that position until his recent resignation.

S. J. Lisberger, formerly engineer of the San Francisco district of the Pacific Gas & Electric Company, has been placed in charge of the division of electric distribution and steam engineering of that company and will be responsible for engineering work on all distribution lines rated at 25,000 volts or lower and of all the company's steam generating stations. Mr. Lisberger was the subject of a biographical sketch published in the ELECTRICAL WORLD for April 3 last.

Paul M. Downing, who early last year was elected vice-president of the Pacific Gas & Electric Company from the position of chief engineer, has in the reorganization scheme devised by the new president, W. E. Creed, received charge of electrical construction, maintenance and reconstruction, together with the operation of all hydro-electric and steam-power houses and substations connected therewith, as well as the street-railway system at Sacramento and all water systems of the company. A fuller biographical sketch of Mr. Downing appeared in the issue of the ELECTRICAL WORLD for Feb. 24, 1920.

P. M. DOWNING

G. C. Heckman has been promoted to the position of superintendent of electrical construction of the Southern California Edison Company. Mr. Heckman was born in Fort Scott, Kan., in 1882, and after graduation from Hanover and from Purdue in 1903 he became electrical-mechanical engineer of the National Board of Fire Underwriters in New York City and gained an extensive experience with fire-fighting apparatus. From 1905 to 1908 he was employed by the General Electric Company as erector, at which time he went to the Hawaiian Islands and installed one of the first turbine-driven dredges ever placed in operation. In 1909 he was employed by the Southern California Edison Company, and since then he has been in charge of the actual installation of all the electrical equipment in that company's new generating stations and substations.

George S. Jones, vice-president of the Guaranty Trust Company of New York, has been elected a director of the Wagner Electric Manufacturing Company of St. Louis, to succeed the late James W. Bell, whose death was recorded in the ELECTRICAL WORLD for Nov. 20.

Irving W. Phillips, who has been associated with Stone & Webster for nine years in construction and maintenance work, has resigned to take charge of the electrical department of Perry & Whipple, mill engineers and architects, at Providence, R. I. Previous to his connection with Stone & Webster Mr. Phillips spent several years in the shops of the General Electric Company at Lynn, Mass., and in hydro-electric construction and operation on the Pacific Coast and in Mexico.

Frank Thornton, Jr., chief engineer of the Westinghouse Electric Products Company, has been appointed manager of the electric heating engineering department of the Westinghouse Electric & Manufacturing Company. Mr. Thornton was graduated from the University of Missouri in 1908 and spent a year studying in Europe. He joined the Westinghouse company in May, 1909, and soon became engaged in engineering work on electric heating devices. In 1918 the Westinghouse Electric Products Company was established at Mansfield, Ohio, and in February, 1919, Mr. Thornton was appointed chief engineer. In September, 1920, all of the engineering activities in connection with electric heating, including both appliances and industrial applications, were combined, and an engineering department was organized with Mr. Thornton as manager.

E. T. Millham has been appointed secretary of the recently organized Rocky Mountain Electrical Co-operative League at Salt Lake City. The duties of the field secretary require him to visit central stations, jobbers and contractor-dealers in the various towns throughout the territory embraced by the league, to promote the objects of the organization through educational methods, to enlighten the public on the subject of the advantages of the use of electricity and to develop the co-operative campaign in every way possible. Mr. Millham is well qualified to discharge these duties, having had a broad experience in electrical work, first at the General Electric Company's works at Schenectady and later with the Utah Power & Light Company and the Hurley Machine Company. His work during the past few years has brought him in close touch with the various branches of the industry throughout the territory which will be covered by the activities of the league. The acquaintance and knowledge of conditions thus acquired will be of considerable value in furthering its objects. Mr. Millham's headquarters will be at Salt Lake City.

Benjamin P. George, who has recently been elected president of the Electrical Credit Association, Central Division, and representative of that division on the Board of the National Credit Association, is treasurer of the Bardslee Chandelier Manufacturing Company of Chicago. Mr. George has been interested in credit matters for fifteen years and closely connected with the electrical industry as credit man for his company since 1908.

B. P. GEORGE

Obituary

Patrick Coyle, superintendent of the Charlestown (Mass.) Gas & Electric Company and in the employ of that organization for fifty-eight years, died recently at his home in Charlestown.

Edward Briggs, for many years connected with the engineering department of the Byllesby organization, died Dec. 10 at his home in Chicago, after a lingering illness. Mr. Briggs was a prominent member of the Byllesby Post of the American Legion.

William E. Francis, marine engineer of the General Electric Company, Schenectady, N. Y., died on Dec. 20 at his residence in Schenectady. Mr. Francis established the marine engineering department of the General Electric Company. During the war Mr. Francis had charge of the installation of turbine engines.

F. G. Jahn, inventor of the machine used for the cancellation of checks, the automatic overhead sprinkler system for extinguishing fires, and many electric motor and generator improvements, died at his home in Brooklyn, N. Y., on Dec. 1 last. Mr. Jahn perfected the stamp cancellation machines now used in post offices and years ago was connected with Thomas A. Edison in perfecting the first phonograph.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Billions Ahead for the Electrical Industry

FOR the last two weeks the newspapers have been able to find many prominent business men, bankers and economists who are willing to disclose the future. Some have been optimistic and some the other way. All, however, have seen one thing, and that is a tremendous business to be done to rehabilitate and build up to the country's comfortable requirements. The disagreement comes when some one tries to foretell when all this will occur.

Now it is true that the work in sight waiting to be done is tremendous. The sum spent during the war for machinery of destruction is small in comparison. There are billions for this and billions for that, and in the aggregate the figures are so big as to be almost terrifying.

Last week the ELECTRICAL WORLD showed, for instance, that the electrical industry will require in the next four years for new plants and appliances $10,371,000,000. A large proportion of this, of course, is for labor in plant construction and installation, but it is interesting to put beside this estimate the figure of $1,250,000,000 which represents the value of the combined output of electrical material during 1920, the largest year on record. Furthermore, the prices taken in the above estimates were not the "high" of 1920 but the "low" of 1912.

Now, where is all this business coming from? A large part is coming from new homes to be wired—the United States Chamber of Commerce estimates that the nation is 1,250,000 homes short at this minute. If the absurdly low figure of $100 per house is taken, already there is $125,000,000 unspent that should now be in operation. These homes will need lamps—millions of them—flatirons, vacuum cleaners, washing machines, fans, fuses, meters.

FARM AND RAILROAD NEEDS WAITING

There are thousands of farmers that are anxious to have electric service, and such installations quickly run into large amounts.

The railroads are now embarking on a plan for rehabilitating our national transportation system. Some roads will electrify, but that isn't the point. The railroads will spend billions of dollars and the producers of the equipment will be in the market for electrical material of all kinds.

For the past five or six years the amount of new street lighting has been pitifully small. This field will reopen soon, maybe this spring, and when things do break they will break big. Underground conduit, cable, lighting standards, globes, time switches and all the necessary equipment will once more be in demand.

Other items, such as new roads, factory extensions, electric railways, development of new territory, etc., will simply help swell the total.

When will it come? Nobody knows. It is pretty well agreed that the first quarter will be quiet; after that better things are expected to happen. The important thing, however, is not when it will occur. The important part is that it is coming and that therefore the electrical industry must be in readiness to avail itself of the golden opportunity just ahead.

There are raw materials to be secured, and some of these, especially copper and cotton, are so low that the prices can hardly go enough lower to make it reasonable for manufacturers to hold off for price reasons. Furthermore, the labor situation is in such a shape that manufacturers can, if they will, get more output per laborer then before and thereby secure lower production costs. In other words, manufacturers can today start on a factory-stocking proposition with production costs in a large degree commensurate with pre-war costs and in that way prepare for the business ahead.

Loom Prices Drop 30 per Cent

RECESSIONS in price of non-metallic flexible conduit amounting to 30 per cent were made just before the year closed. On Dec. 27 one producer made the cut which started the ball rolling, it is understood, and within two days the other producers were down to the 65 per cent discount, a change of 15 points.

With the low cotton market, the price of cotton materials entering into the make-up of loom has dropped considerably, in some cases as much as one-half, so right there is a cause for a lower price. It has been felt, too, that loom prices were still high and that lower prices at the opening of the year might have some effect on the very slack market now prevailing. There is plenty of labor available at cotton fabrication mills and plenty of cotton material at hand, but with the mills running light there is no reason for prices to stay up with the demand so low. It is a case of keep the mills running and the personnel together, and pocket the loss and be rid of it once and for all, starting the year with a clean slate.

Banks and Customers Still Need Light on Acceptances

TRADE acceptances have made it possible for the Western Electric Company to decrease its credit losses to the percentage shown in the following table, according to E. W. Shepard, general credit manager of that company, in an address before the twenty-fifth annual convention of the Electrical Credit Association, Central Division, in Chicago recently.

	Trade Acceptances	Open Accounts
1918 losses	0.03	0.39
1919 losses	0.07	0.27

The company's turnover was 15 per cent greater in 1919 than in 1918, and 1920 showed an increase of 12 per cent over 1919. The increase in turnover was obtained by discounting the trade acceptances. The net result has been to increase the net return on the company's investment by the use of trade acceptances.

Trade acceptances have been found to improve the credit rating of the company's customers with bankers, and they have also helped to make the customers appreciate the advantage of turnover. With the exception of the United States Government railroads and most municipalities, the Western Electric Company takes trade acceptances from all customers who do not take the cash discount or pay their bills net in thirty days. The time taken by a customer to pay his bill is not considered to be so important as knowing that he will pay it on a certain date. For this reason a customer who gives a trade acceptance and meets his obligations when due is considered as good a customer as one who takes the cash discount.

More trade acceptances are now being returned than ever before, but this increase is not out of line compared with overdue notes and open accounts. An overdue account is

easier to detect in a trade acceptance because it stands out more sharply in the records. The average time for the company's trade acceptances is forty-seven days for the first eleven months of 1920.

Trade acceptances are designed to allow the customer a sufficient time to sell his goods before paying for them and should therefore only be used for current due accounts. The Federal Reserve Bank will not rediscount trade acceptances which have been renewed, and if a customer cannot pay a trade acceptance when due, the proper way to give him additional time is by means of an interest-bearing note. Trade acceptances should not be used for the purpose of borrowing, nor should they be issued on past-due accounts.

Banks prefer to handle trade acceptances in as large amounts as possible, it is found. For this reason groups of orders, say for a month, should be grouped on one acceptance with an average date. By this means the Western Electric Company increased the average amount of its trade acceptances from about $800 in 1919 to about $1,000 in the year 1920.

Light Demand for Electric Ranges in the Northwest

DEMAND for ranges in the Northwestern States has fallen off perceptibly. Coupled with the general tendency of the public to spend money less freely than in the past two or three years, it is felt that the cost of the range is too high. At the same time, while the cost of wiring in a service, which amounts to from $60 to $75, is considered to be pretty high also, this is really not so much of a factor if the purchaser is willing to pay present prices for the range.

Power companies in the Northwest have not been pushing this business very hard recently because of a general shortage of power. Stocks of standard lines of ranges are reported in good condition, even though there have been increasing sales activities among the trade to move them. It is felt that cooking rates are reasonable and compare favorably with gas. In Portland, if the proposed increase in gas rates is granted, it would be reasonable to expect an increase in demand for electric ranges.

Independent Pipe Prices Decline

THE last day of the year saw the decline to Corporation price level of the last of the steel products manufactured by independent mills—pipe. This, of course, affects the price of rigid conduit, and the mills are now on card 44. So there comes to an end the two steel markets—the Corporation and the independent. It was about the middle of November that the equalizing of these two markets began when independent prices of tin plate were reduced to the Corporation level—the Industrial Board level of March, 1919—and from then on the spread of other steel products has gradually diminished until now there is but one market. During the present week, however, other independent mills have followed the course of the one which acted on Dec. 31.

Heating Device Schedule and List Prices Changed

WHILE an increase in license schedule prices of domestic heating appliances was made effective Jan. 1, 1921, the ELECTRICAL WORLD is informed that this change is to be rescinded, so far as it applies to hollow ware, as of Jan. 15. The action prompting the increase, it is learned, was taken in order to make the schedule prices a little more commensurate with manufacturers' prices, which are still above the schedule.

Already one manufacturer of heating devices has issued new price lists as of Jan. 1, showing about 10 per cent lower list prices, and it is known that other manufacturers will issue lower lists shortly. Still other manufacturers state that they will not lower their lists at this time.

Domestic Production of Copper in 1920

THE smelter production of copper from domestic ores during the year 1920 is estimated by H. A. C. Jensen of the United States Geological Survey to be about 1,235,000,000 lb., compared with 1,286,000,000 lb. for 1919. Production of refined copper from foreign and domestic ores for the year was about 1,573,000,000 lb., which is approximately 195,000,000 lb. less than for the year 1919. Apparent domestic consumption was about 910,000,000 lb.; in 1919 it was 877,000,000 lb. Stocks of raw and refined copper at the end of 1920 were about 874,000,000 lb., which represents a decrease of 30,000,000 lb. from those held at the end of 1919. Total imports of raw and refined copper for the ten months ended Oct. 30, 1920, according to the Bureau of Foreign and Domestic Commerce, were 407,437,515 lb. Exports of copper for the same period were 543,695,851 lb., compared with 516,627,775 lb. for the entire year 1919.

Continued decreased production, large stocks and low domestic consumption were due entirely to the generally depressed conditions of industry throughout the world, which did not permit the absorption of such great quantities of copper as had been hoped for. Low exchange and the great stocks of scrap and secondary copper available both in the United States and abroad also decreased the demand for new copper. The salient features of the copper industry during 1920 were a small hesitating demand, decreased production, continued small exports, particularly during the last half of the year, and labor troubles.

Metal Market Situation

COPPER has receded to a still lower level at which producers have made sales at 13 cents, delivered, in the first quarter. The outside market has gone as low as 12.50 cents, delivered, for nearby consumption, while some smaller producers are holding to a middle ground at 12.75 cents, delivered, for first quarter. A much better buying interest had developed by Wednesday. Speculators have been showing considerable interest in the market, but producers are unwilling to sell them large lots except at a premium.

Now that the year's end has passed and the immediate necessity of light inventories has been met as far as possible, it would seem that the present time offers manufacturers of electrical apparatus a propitious market for the purchase of copper stocks. It does not seem that copper will be available at a price sufficiently lower than that ruling at present to warrant consumers of large amounts holding off any longer for lower prices.

In line with a certain domestic demand which must rule during the coming year, a further foreign market appears in the offing as the result of the passing over the President's veto by the two houses of Congress of the Federal Finance Corporation bill bringing back to life this organization. This action, if backed by a sufficient appropriation, might result in large purchases of copper by the European countries so badly in need of it and so short of immediate funds.

NEW YORK METAL MARKET PRICES

	—Dec. 27, 1920—	—Jan. 4, 1921—
Copper	£ s d	£ s d
London, standard spot	72 5 0	72 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.75	13.50
Electrolytic	14.00	13.00
Casting	13.00	12.37½
Wire base	16.00–16.50	16.25
Lead, trust price	4.75	4.75
Antimony	5.25	5.20
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Zinc, spot	6.00–6.10	6.10
Tin	33.00	36.00
Aluminum, 98 to 99 per cent	28.50	28.30

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00–11.50	10.50–11.00
Brass, heavy	6.00– 6.50	6.00– 6.50
Brass, light	4.50– 5.00	4.00– 4.50
Lead, heavy	3.50– 4.00	3.50– 3.75
Zinc, old scrap	3.25– 3.50	3.00– 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WITH jobbers busy counting up their stocks there is little trade in the electrical supply field. Inquiries are getting smaller and smaller and are now few. Buying is as low as it is expected ever to get. There is more shopping being done. Stocks in general are high, demand is light and money is scarce, consequently price is a big factor when it comes to making a sale today. Jobbers are more inclined to seek business than they were a short time ago. Where heretofore the dealer called up and begged for a few appliances from several jobbers today the jobber is calling up the dealer offering him trucking facilities on a purchase.

Over the year's end prices of conduit, loom and flexible armored conductor saw important recessions. One line of domestic heating appliances also dropped. The two steel markets lost their identity and became one. Collections continue long and require constant pushing.

NEW YORK

The arrival of the new year brings little immediate encouragement to the electrical trade in the way of a return of business. Hopes of increased demand have now been deferred until after the first quarter at least. Some jobbers even go so far as to say they expect slack conditions to obtain up to the half-year mark. Some houses have finished taking inventories, others are just now in the middle of this occupation. Reports thus far indicate a surplus varying from 20 to 100 per cent compared with the level of stocks at this time last year.

Price cuts continue to be made, the principal items affected this week being loom, locknuts, washers and bushings and armored conductor. Wire and conduit are also being shaded to their recent low levels by more jobbers. Collections continue unsatisfactory with no change.

Locknuts, Washers and Bushings.—Price decreases are reported as going into effect the first of this week amounting to about 33 per cent on ½-in. and ¾-in. sizes and about 8 per cent on the others.

Conduit.—Demand is slow and stocks are well built up in virtually all sizes. In quantities of 2,500 lb., ½-in. black ranges from $70 to $82, and 1-in. black from $155 to $160.50 per 1,000 ft., net.

Outlet Boxes.—Light demand and a plentiful supply are reported. The discount on black boxes ranges from 20 to 30 per cent and on galvanized from 15 to 25 per cent in quantities of 100.

Flexible Armored Conductor.—The market remains very weak with plenty of material available, though some jobbers have forced their stock to low levels. Prices are all over the lot, with some jobbers down to $65 net per 1,000 ft. for No. 14 two-wire and others ranging all the way up to $85.

Wire.—Stocks of both rubber-covered and weatherproof are large under the poor demand that is felt, though one or two houses report a slight pick-up in sales of rubber-covered wire. No. 14 rubber-covered ranges in price from $8.50 to $9.50 per 1,000 ft., in 10,000-ft. lots. Weatherproof wire base is 19 to 20 cents, with No. 14 in 250-lb. lots quoted from 27 to 29 cents.

Non-Metallic Flexible Conduit.—Buying interest is almost completely lacking, and stocks are large. Price reductions from manufacturers amounting to 30 per cent went into effect last week. Under the new schedule jobbers quote ¼-in. in 1,000-ft. lots from $27 to $29.50 and $\frac{7}{32}$-in. from $25 to $27 per 1,000 ft., net.

Poles and Hardware.—Demand is generally light. Stocks of poles, pins and cross-arms are good at distribution points, deliveries to the East being made as quickly as two weeks. Cross-arms were reduced in price about 10 per cent early in December. Hardware stocks are small, though sufficient for current light needs. Deliveries range two to three weeks. Price decreases averaging 10 to 15 per cent have been made by different manufacturers during the month of December.

Distribution Transformers.—Demand in this territory varies from fair to very good. Deliveries are improving and range from twelve to fifteen weeks on the smaller capacities up to fourteen and twenty weeks on large sizes. These figures compare favorably with a few months ago, however. Stocks are spotty, but are beginning to build up, almost half the sizes now being in stock. Prices are steady.

Fuses.—Stocks are ample to care for the present slow demand. In standard packages, N.E.C. standard 3 to 30 amp., 250-volt non-renewable fuses are quoted from 12.50 to 15 cents each, net.

CHICAGO

Because most concerns in the district are doing nothing but taking inventory, and also because there have been absolutely no developments in the way of price changes, any attempt to mention specific items or classes of materials in a trade review is superfluous this week. The industry locally is vitally interested in those factors which bear on the future of the electrical industry and which are outside the control of the industry.

Chicago has an enormous building program laid out which will go ahead in 1921 if price adjustments are made in time to permit the letting of contracts early in the year. The estimated total of $150,000,000 worth of work ready to go ahead includes two department stores, six theaters, five office buildings, six hotels, four club houses, several university buildings and $9,000,000 in public school buildings. There is also the vast project of electrification of the Illinois Central terminus as well as innumerable private-home building enterprises which will certainly go ahead just as soon as the men who are in control of expenditure think that prices have been stabilized sufficiently to justify such action.

Concerning non-employment it is a significant fact that those industries which first started to take up the slack and get their production costs and selling prices down to a reasonable base, considering their probable future, are right now resuming operations. This is held to justify the opinion that all other industries, just as soon as they effect their necessary readjustment, may do likewise and that there is nothing to fear in the way of a long-continued period of widespread depression.

Collections for December are going to look a little better than they did in November. This is on account of extra collection efforts put forth with the approach of the new year. Money is still very tight and is not to be collected unless vigorously gone after. The volume of outstanding accounts on the books of both manufacturers and jobbers is steadily declining, as the sales right now are at a low mark, while old accounts are being steadily reduced.

What the attitude of the public as a whole is going to be toward buying is the main interest just now. In its relation to the electrical industry, the future of construction is the most important factor, as, without new apartments, hotels, office buildings, etc., the market for equipment will be limited. In this connection prices of building materials are the leading question. Lumber is down in the local market to a point about equal to pre-war prices, if increased freight rates are taken into consideration. Most other materials still remain up toward the top of the price range and, with the exception of copper wire, electrical equipment is there also.

BOSTON

Jobbers report a better feeling in New England mill circles as the business year opens. Many plants which were shut down have reopened for part time or full time operation, and greater interest is seen in betterment work along engineering lines. The volume of orders has not increased much as yet, but field men from prominent jobbing houses note a turn for the better in local districts. Building and engineering contracts for 1920 to Dec. 29 in New England totaled $304,230,000, about 25 per cent larger in amount than for the same period of 1919 and nearly 50 per cent greater than in 1916, the second best year in the past two decades.

Jobbers' stocks are uneven but are still overloaded in many lines. One good-sized house had $500,000 worth of material on hand at the week end and was buying only immediately scarce products. Collections are poor and borrowing to discount bills is being practiced in some jobbing circles. With the exception of rigid conduit deliveries are very satisfactory. Prices broke sharply last week in flexible-armored conductor and non-metallic flexible conduit; wire continues weak, and one of the largest appliance manufacturers has marked down some of his leading products about 10 per cent, effective Jan. 1. Industrial heating equipment is firmer.

Flexible Armored Conductor.—No. 14 single-strip is off sharply to about $65 to $68 per 1,000 ft. Large quantities are selling for considerably less, with no fixed price for stated amounts.

Non-Metallic Flexible Conduit.—Prices are weak owing, it is believed, to the slump in cotton quotations. On Monday the $\frac{7}{32}$-in. size in 1,000-ft. lots brought $22 and the $\frac{5}{16}$-in. size $25 per 1,000 ft. Plenty of this material is to be had and the demand is moderate.

Motors.—Barring rather spotty stocks it is easy to pick up sizes required if quantity orders are not sought. Prices are firm, although some rumors of a moderate readjustment are in the air.

Meters.—Central-station buying keeps up well, and low stocks or none at all in some cases are the rule.

Appliances.—Landers, Frary & Clark announced reductions in list prices Jan. 1, of which the following decreases are representative: Grills and ranges, $0.75 to $2.50; heating pads, $1; immersion heater, $1; irons, $0.25 to $1.25; percolators, $1.50 to $3.50; toasters, $0.75 to $2; water heaters, $0.50; disk stoves, $1.50. A fair holiday business is reported among retailers.

Industrial Heating Equipment.—Prices were advanced by Landers, Frary & Clark Jan. 1 on glue pots and soldering irons. On the former the lists were increased from $1 to $3.50 and on the latter from $1.75 to $2.75.

Wire.—Rubber-covered wire is weak, No. 14 selling at $9 per 1,000 ft. in 5,000-ft. lots. Weatherproof base is 20 cents and bare base 17½ cents. Stocks are on the whole in excellent shape for meeting increased demand.

Rigid Conduit.—Pipe is easier in price, ½-in. black being quoted at $78.20 per 1,000 ft. in 10,000-lb. lots, with $83.30 for galvanized. Deliveries are somewhat slow and stocks are spotty. Quotations fell about 10 per cent last week. The demand is moderate.

Knobs and Tubes.—Easier deliveries are reported. Prices are running around $11.50 per 1,000 on 3-in. tubes and $32 per 1,000 for "Nail-it" knobs in barrel lots.

ATLANTA

The closing of the calendar year has brought with it the usual decline in business activities, the buying public apparently satisfying its requirements in the pre-Christmas period. Jobbers are receiving a minimum of orders, whereas the retailers are buying only for immediate current needs, making every effort to reduce stocks for inventory.

Jobbers and retailers alike report that stocks in the main are considerably lower than for last year and will make no effort to replenish before the middle of January. The final résumé of building activities in Atlanta for 1920 shows a grand total of $13,342,011, the activities being divided into the following classes: Dwellings, 38; apartments, 39; churches, 11; commercial houses, 124; factories, 11; public buildings, 9. However, December permits were low, with a valuation of only $269,000. Much of this construction is still under way, which means that building supplies will be in demand for some time to come in the South.

The opinion that general business conditions will improve is reflected by the opening up of textile mills that have been closed down, while oil mills will recommence operations shortly after the first of the year. Little or no curtailment is reported from other classes of manufactures, and while some wage reductions are reported non-employment is not heavy. The electrical trade reports indicate that all houses had a most satisfactory holiday trade, with business well in excess of that of last year but not quite up to the estimates of the early fall. Collections continue rather slow, though those from municipalities show improvement, owing to collection of 1920 taxes.

Flexible Armored Conductor.—All jobbers report very good stocks, but they are moving slowly, which probably accounts in a great measure for the sharp price break to be noted this week. One large jobber is quoting two-wire No. 14 double strip in lots of 10,000 ft. at $75 to $80 per 1,000 ft.

Cross-Arms.—This week has seen an unusually good movement of cross-arms and pole-line material; in fact, the movement of this class of supplies has been better than any other line for the past ten days. No price reductions are reported, though jobbers are anticipating such in the very near future. Prices: Standard fir arms, two-pin, 4-ft., lots of 1,000 linear feet and over, 62 cents each; four-pin, 4-ft., 83 cents. N.E.L.A. fir arms, two-pin, 3-ft., 93 cents each; four-pin., 5-ft. 7-in., $1.41 each. Pins, 1¼ in. x 8 in., $2.50 per 100; 1½ in. x 9 in., $4.20.

Wire.—No further reduction in the price of wire is noted, rubber-covered moving fairly well, while weather-proof is more active. Stocks are on hand in practically all sizes in quantities sufficient to take care of reasonable current demands.

Rigid Conduit.—Activities in this line continue to hold up much better than was expected and stocks have become somewhat spotty because of jobbers' failure to reorder. Prices remain steady.

Safety Switches.—Jobbers report very heavy stocks in all sizes, due to overestimating their demands. Popular sizes are moving quite well, and the new ruling which practically prohibits open switches in boxes will still further stimulate sales.

Motors.—Scanty stocks have been accumulated, and popular sizes are still hard to obtain promptly. Manufacturers express the opinion that they will not catch up on all back orders before midsummer.

ST. LOUIS

The past week has proved itself to be a more than ordinarily quiet one for both jobbers and dealers. Until Christmas sales of holiday and seasonable goods helped to compensate for the decrease in sales of staple lines, but following Christmas the demand for appliances and seasonable items dropped off sharply. It is expected that this will be only a temporary manifestation inasmuch as dealers have stopped ordering so that they may hold down their inventories and will commence to stock up again as soon as they have finished taking these. Dealers report that there is very little retail buying. A central-station company which is putting on a sale of appliances, lamps, etc., reports good sales, however.

The Federal Reserve Bank of the Eighth District, in its report for December, asserted that the Christmas trade had been the poorest since 1913. Electrical jobbers and dealers, however, while reporting a volume of business overshadowed by that of last year agreed that the season had been satisfactory in view of general conditions. Credit

conditions show no change. The average maintained is around sixty days. Very few customers' notes are being accepted.

Outlet Boxes.—Stocks have bettered appreciably, though some jobbers still report a little difficulty in getting delivery from manufacturers. Prices have not changed, the maximum discount on the black boxes remaining at 40 per cent and that on the galvanized at 35 per cent.

Vacuum Cleaners.—Dealers continue to dispose of these appliances and are placing orders, though not so heavily as a month ago. Immediate delivery can be made on fairly large quantities.

Washing Machines.—Christmas sales were low. Dealers reported public sentiment in favor of a substantial reduction in prices and feel that demand will continue to be light until this reduction is an accomplished fact. Production of washing machines in this territory has been cut considerably because of continuing high costs and the dead market. Both manufacturers and jobbers have accumulated large stocks.

Insulators.—Stocks of glass insulators are still spotty. Jobbers have been unable to complete their reserve stocks, in spite of better deliveries from manufacturers, because of the continued strong demand. Stocks of porcelain are little better, and jobbers do not expect to be able to build up complete stocks for several months to come.

Locust Pins.—Jobbers have large stocks, and sales remain light, though rural demand is showing flashes of activity. The 1¼-in. x 8-in. pins are quoted around $30 per 1,000 in lots of 5,000 and the 1½-in. x 9-in. pins around $60.

Wire.—The market is more unsettled than ever. Any quotations that are made are nominal. Stocks have not shrunk appreciably in the last week.

Heaters.—Sales are still good, though they have dropped off slightly since Christmas. A sale by a central-station company brought forth a particularly good response this past week.

Flexible Armored Conductor.—The number of sales is fairly large, though a smaller volume is reported, there being a quite noticeable decrease in the size of individual orders.

SAN FRANCISCO

Non-employment is increasing, and for the first time in several years additional clerks, salesmen and solicitors are available. It is expected that sales of the larger household appliances, which have lain dormant in several sections through lack of proper selling efforts, will again be vigorously pushed.

Switches.—More drastic observance of state safety regulations will cause an increased demand for safety switches, although, as these are not required where there are voltages of less than 150 volts to ground, there will still be a big field for the sale of ordinary knife switches.

Farm Plants.—Probably because of severe weather conditions which prevent active solicitation by field salesmen farm-plant sales have decreased. A few sales have been noted here and there. A new field of sale for farm plants has been found among theaters in the interior towns where the current frequently is cut off for short periods of time.

Telephones.—A considerable amount of telephone extension has been planned or 1921, especially among the towns of the lower San Joaquin Valley. Factory deliveries are improving.

Insulating Material.—Deliveries of insulating material are better despite increased demand among the motor-repair shops. New fields of sale among auto-repair shops and railroad-car repairing shops are now being supplied.

Lamp Cord.—For the present no attempt will be made to enforce regulation of the use of ⅜-in. fixture cord. The fixture manufacturers state that it is difficult to make loops with a heavier cord. There are still big Coast stocks of the ⅜-in. style.

Line Material.—For many months to come this will be one of the greatest selling lines because of big power projects and the great amount of necessary house and building wiring that is being held up.

Cross-Arms.—Local stocks of cross-arms are better than they have been for years. Decreasing business by local lumber companies has resulted in a crop of vigorous competitors for cross-arm business.

SEATTLE—PORTLAND

The annual depression is on and sales of both jobbers and dealers are at a minimum. Overstocks in several lines are noted, an oversupply of hollow ware being especially prominent. During the past week a few minor reductions in prices were made, but the changes were inconsequential. Sales during December, aside from strictly holiday business, were about the same as last year; holiday sales were much lighter. In spite of present conditions the majority of electrical concerns insist that a change for the better will develop within thirty to sixty days.

The Pacific Northwest lumber industry enters the new year with the lightest order files in its history and the heaviest inventories of the past decade. With financial conditions temporarily retarding new construction adverse exchange operating against exports and advanced freight rates restricting the use of West Coast lumber in markets east of the Mississippi River, the outlook for the first quarter of 1921 is not encouraging. In the electrical industry credit continues to tighten. Collections are no better, although intense activity on the part of collection departments in some instances has shown favorable results.

Jobbers report that Christmas tree outfits were ordered very lightly last year, but that in spite of this there was an oversupply. This also applies to heating appliances, which were ordered heavily and did not move. Large stocks will be carried over. Wire continues to show a downward tendency and Thor washing machines have been reduced to prices prevailing previous to the recent raise. Porcelain stocks are improving. Galvanized conduit in large sizes is still scarce, but stocks of black conduit are in good shape.

Motors.—The stock situation is very much relieved. In the case of some of the larger sizes there is at least six months' stock on hand. On smaller sizes, in which there is more active demand, the manufacturers are less than six months behind on orders. Fractional horsepower motors are still very difficult to get.

Lamps.—Stocks are reported the largest in history. Lamp sales eased up somewhat in November but improved again in December and are good at the present time. Industrials this year have been buying more lamps than heretoore, principally in type "C" sizes.

SALT LAKE CITY—DENVER

Electrical dealers and jobbers are starting the new year with a determination to make business good. The tide of pessimism seems to be stemmed successfully, and it can be said that the general business morale is excellent. Business is not actually much improved, but most electrical merchants are backing up their faith by making out budgets that contemplate a bigger volume of sales in 1921 than in 1920.

The big topic in salesmen's conventions is ways and means for stimulating sales in this buyers' market. Extra service and constructive help to dealers will be the big 1921 issue from the jobber's point of view. Dealers in turn recognize that merchandise is not any longer at a premium and that many things will have to be resorted to to create a productive consumer demand.

No material price reductions have been reported from manufacturers, and consequently no general recession is noted on the consumer market. In scattered cases dealers have had to make cuts in order to liquidate and make peace with their creditors, but the general tone of the market is stable. The credit situation continues to be difficult and involved. Collections are extremely slow, with little prospect of immediate improvement. Building activity is virtually at a standstill. It is thought, however, that the falling market in building materials will have a stimulating effect by spring.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Mohawk Electrical to Move to Much Larger Quarters

In following out the policy of publicity in advance, the Mohawk Electrical Supply Company, Syracuse, N. Y., A. M. Little, president, announces that the company is going to move along in April into what he characterizes as one of the finest buildings employed in the electrical supply jobbing business in the United States. The company has taken over a six-story and basement building, 50 ft. x 100 ft., at 529-533 South Clinton Street, of brick, steel and concrete, giving two and one-half times former capacity for stock, equipment and general facilities.

Big Pacific Wire Order Goes to Anaconda

Ten million pounds of copper will be required to fill the order which the Anaconda Copper Mining Company, Great Falls, Mont., has just received from the Pacific Gas & Electric Company, San Francisco, Cal., for transmission wire for the power company's new 220,000-volt lines. The finished cable will have a 500,000-circ.mil. cross-section, made up of seven-conductor, seven-rope lay strand, and is the largest rope strand which the company has had to build. An additional order of 3,500,000 lb. is expected to be placed during January, with a further quantity of 5,000,000 lb. before the year is out.

The cost of the cable will be about $1,750,000, based upon 14-cent copper. During the first quarter of the new year the power company will make payment of the cost of the copper involved, the balance, representing fabricating costs, to be paid as deliveries of the cable are received. Shipments will be started in May or June and will be continued at the rate of over 1,000,000 lb. a month.

It is interesting to note that this is the only company making bare copper wire west of the Mississippi and that by so doing the freight costs of sending raw wire materials East and finished wire West are eliminated.

Edison Storage Battery Plant Not Closed

Announcement was made this week by Charles Edison, chairman of the board of directors of Thomas A. Edison, Inc., that the storage-battery works were not included in the Edison shutdown on Dec. 29. Only the phonograph instrument works were closed on that date. The storage-battery works and the divisions of the Edison industries, it was stated, are continuing operations.

Gregory Cuts 100 per Cent Stock Melon

The Gregory Electric Company, Chicago, one of the largest dealers in used electrical equipment in the United States, has been authorized by the Secretary of State at Springfield, Ill., to increase its capital to $1,000,000. This increase in capital stock, the company states, has become necessary through the increase in business. At a meeting of the board of directors on Dec. 24 a stock dividend of 100 per cent was declared.

All-Electric Vehicle Show for New York

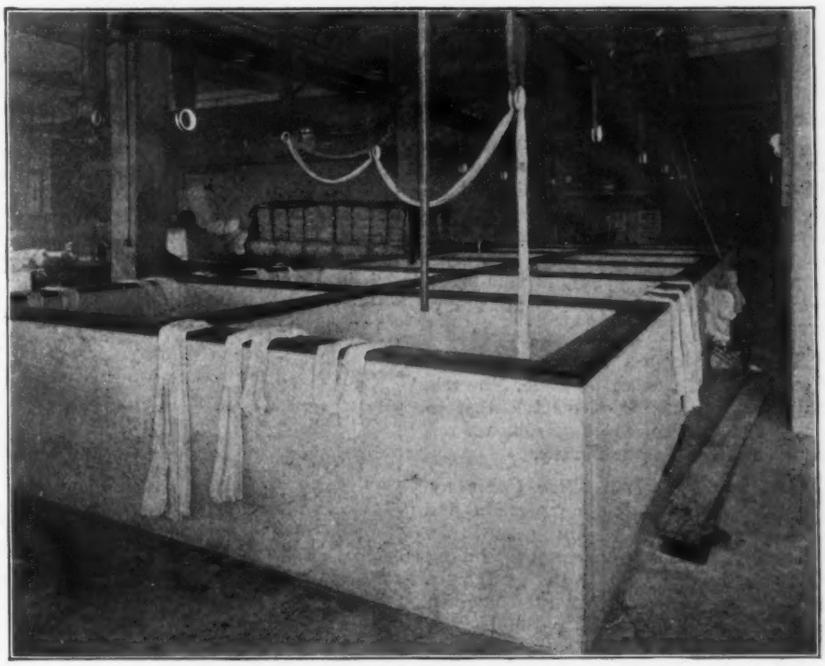
Following what was felt to be the need for an all-electric vehicle show the New York Edison Company is to stage a two weeks' show of electric storage-battery vehicles in its showrooms at Fifteenth Street and Irving Place from Jan. 29 to Feb. 12. Leading manufacturers of electric vehicles and accessories have accepted the invitation sent out by the Edison company so that there is assured what is said to be the first electric vehicle exhibition of its kind. During the week of Jan. 29 street trucks and passenger cars will be displayed, while the following week will be devoted to industrial trucks. Batteries and accessories will be on display both weeks.

Japan Orders 1,000 Steel Towers

An American fabricating company is to supply about 1,000 steel towers for transmission lines for the Nippon Electric Power Company, Osaka, Japan. The Blaw-Knox Company, Blawnox, Pa., has received the order for 6,000 tons of steel towers at a figure of about $800,000 for this 140-mile line of 160,000-volt parallel circuits. Fabricating will begin at once, and shipment will be made in the late spring or early summer.

Insulation Producer Operates Own Bleachery

The bleachery of the Irvington Varnish & Insulator Company, Irvington, N. J., which was installed a year ago for bleaching and finishing cotton fabrics for use as electrical insulation, has a capacity of 1,500,000 sq.yd. per month. It is stated that this is the only company producing cotton insulation, not only in the United States, but also in the world, which has its own bleachery. The building is one story in height and covers an area of 100 ft. x 200 ft. The company has fifty-six cooling towers in operation and has ten more under construction. A new 200-hp. boiler also is being added.



CAPACITY PER MONTH IS 1,500,000 SQUARE YARDS

New Record in Electric Bake Ovens

What is claimed by the manufacturer as a new record in large electric bake ovens has just been completed for the B. Manischewitz Company of Cincin-

nati, Ohio, by William F. Schaller, engineer for the Ideal Electric Traveling Oven Company, Inc., of San Francisco. The oven is 62½ ft. long and 9 ft. wide. The temperature, it is claimed, averages 650 deg. F. during operation under an average load of 100 kw. This new oven, which has a baking capacity of 9 barrels of flow per hour, is used for baking matzos.

Baker R & L Sees Prosperous Times Ahead

As the result of reports of all kinds the Baker R & L Company, Cleveland, builder of electric trucks and tractors, views the near future optimistically. The company is stocking on trucks and tractors in anticipation of large quantity orders on which it is now working.

The company's belief in prosperous times ahead is evidenced by its additional investment of nearly $250,000 in finished Baker trucks and tractors since business began to slacken up.

The Power Plant Engineering Company, Seattle, Wash., has been incorporated and offices have been established in the L. C. Smith Building. The company is composed of engineers experienced in power-plant installation and operation, and it is in a position to contract for, design and install all power equipment. It also has the exclusive agency for the Santmyer powdered coal equipment. W. J. Santmyer is president, R. S. Whaley is vice-president, and A. E. MacInnis is secretary-treasurer.

The Hochbaum - Rylander Electric Company, 539 Central Avenue, Newark, N. J., manufacturer of electrical products, has filed notice of dissolution under the laws of New Jersey.

The Page Steel & Wire Company, manufacturer of steel suspension and guy wires, has taken over the tube business of the Connecticut Tubing Company and has moved the equipment to its Adrian (Mich.) plant, to which a one-story addition, 50 x 286 ft. will be added at a cost of about $60,000.

The National X-Ray Reflector Company has appointed Cochrane, Stephenson & Company, Ltd., of Winnipeg, Can., as its representative for western Canada. The firm will act in the capacity of sales representative for the complete line of X-Ray products. Mr. Cochrane was for twelve years sales manager of the Northern Electric Company in western Canada.

The Woodrow Manufacturing Company, Newton, Iowa, washing-machine manufacturer, has completed a film for distribution to dealers as an aid to their local advertising. The film, which is 1,200 ft. long, shows the progress of the art of washing clothes from the days of Eve to modern times.

The Sterling Lighting & Fixture Company, Buffalo, N. Y., has filed notice of increase in capital stock from $2,500 to $25,000.

The General Electric Company, Schenectady, N. Y., is having plans prepared for the construction of its proposed plant on Elmwood Avenue between Sixty-eighth and Seventieth Streets, Philadelphia, to cost, including machinery, about $500,000. The building will be about 80 ft. x 600 ft. and will be used for the most part for the manufacture of switchboard equipment.

The Western Electric Company moved its supply division in Alanta into a new five-story office and warehouse on Nov. 23. This new warehouse, which provides 60,000 sq.ft. of space, is near the center of the business district of Atlanta, convenient to the company's local supply customers. The company's supply department offices were formerly in the West End suburb of Atlanta, where the stocks of telephone equipment will still be maintained. The new warehouse is equipped with gravity conveyors and dumbwaiters so as to make the handling of material convenient and rapid. It also has a large conference and display room where customers can inspect equipment. About 200 clerks and salesmen are required, with offices on the top floor. Branch offices are now maintained in Jacksonville, Fla., New Orleans and Savannah, Ga. H. W. Hall is district manager of C. A. Cabaniss is sales manager.

The Engineering Business Exchange, 30 Church Street, New York City, announces the opening of a Pacific Coast branch with James T. Whittlesey as director and with offices in the Claus Spreckles Building, San Francisco. Mr. Whittlesey was long a prominent figure in the street-railway field, and since his removal to California eight years ago he has been engaged in general consulting practice.

The Thompson Electric Company, 226 St. Clair Avenue, N. E., Cleveland, Ohio, announces that it is once more on a production basis and expects to be able to make prompt shipments from now on.

The Bowen & Bartlett Company, Inc., 1201 South Sharp Street, Baltimore, Md., has increased its capital stock to $200,000. The company manufactures washing machines.

The H. B. Sherman Manufacturing Company, Battle Creek, Mich., has acquired an electric motor plant at Quincy, Ill., which it will move to Battle Creek. The company, it is understood, will build a new plant as soon as business warrants. It manufactures brass and bronze castings.

The National Council of Lighting Fixture Manufacturers and the Lighting Fixture Dealers' Society will meet in Buffalo, N. Y., during the week of Feb. 14.

Foreign Trade Notes

BULGARIAN CHAMBER CONSIDERING WATER POWER DEVELOPMENT.—The Bulgarian Chamber, which is considering a bill to regulate water syndicates, according to the London *Electrician*, is also giving its attention to the question of developing water power. Investigations have been made as to the utilization of the water power of a number of rivers, and the Board of Trade *Journal* states that the results show that the water-power resources of Bulgaria are capable of developing more than 1,000,000 hp. Railways and industries will consume only 130,000 hp. to 150,000 hp., and the remainder will be available for agricultural purposes and lighting. An extensive irrigation scheme is also contemplated, including the irrigation of the plain of Deli-Ormana by means of electrically driven pumps. The projects to be taken in hand will include the construction of about seventeen barrage reservoirs, building electric power stations and also canal systems in the Plains of Thrace, Stara Zaroga, Yambol and Sliven in southern Bulgaria, and in northern Bulgaria on the lower courses of the Rivers Isker, Vid, Ocem, Rositza, Yantra and others, as well as the Plains of Kustendil, Radomir, Doupnitza and Nevropol. A Supreme Water Council has been established at the Ministry of Agriculture and State Property to execute.

THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT has announced for the past business year net profits of 47,705,000 marks as against 27,031,000 marks in the preceding business year. Inflation of currency in Germany, it is stated, has been reflected by an extraordinary inflation of business profits during the period before the great reaction in prices.

TENDER DATE POSTPONED FOR THE NORWELL HYDRO-ELECTRIC PROJECT.—Owing to the delay in the transit of the specifications of the electricity commission of the State of Victoria, Australia, for the Norwell hydro-electric project, the commissioners have postponed the date for delivering the tenders to the secretary of the commission in Melbourne, Australia, from Feb. 24 to March 31, 1921. These specifications are now on sale at the bureau's district offices, 734 Custom House, New York City, and Room 1424, First National Bank Building, Chicago, Ill.

HYDRO-ELECTRIC PLANT IN NEW SOUTH WALES.—Announcement has been made by the Prime Minister that it is proposed to establish a hydro-electric power plant on Murray River at Albury, New South Wales, Australia, to generate electricity in connection with the industrial development of the border districts in New South Wales and Victoria.

PRODUCTION OF ELECTRICAL APPARATUS IN POLAND.—The manufacture of electrical supplies in Poland is in its infancy. According to the latest statistics available there are twelve plants, employing about 1,200 workmen, manufacturing electrical products, including supply apparatus, electric motors, cable, carbon lamps, carbons for arc lamps, insulating tubes and similar products.

GERMAN ELECTRICAL GOODS IN THE FAR EAST.—German manufacturers, according to Trade Commissioner Lundquist, are furnishing a number of electrical houses in Bombay, India, with electrical apparatus, including wire, wiring supplies, fixtures, meters, motors, etc.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An engineering company in India (No. 34,172) desires to secure catalogs with a view to purchasing decorative electric lamps, such as are used for Christmas trees, with cords for 220-volt circuits; electric signs and flashers, fancy crystal shades (electrical glassware), and opal glass-ball shades, 6, 8 and 10 in. in diameter.

A commission merchant in Turkey (No. 34,175) desires to enter into communication with firms with a view to securing agencies for the sale of metallurgical products, transmission belts, machinery, motors, pumps, turbines, etc.

A manufacturing company in Spain (No. 34,179) desires to purchase and secure an agency for electrolytic copper-wire bars with a guaranteed minimum combustibility of 98 to 99 per cent. Copper blocks for laminating are also desired, and copper and brass in all forms, etc.

New Apparatus and Publications

TAILORS' IRONS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently issued publication 877, describing its electric tailors' irons.

INSTRUCTIONS FOR CARE OF TRUCKS AND TRACTORS.—The Automatic Transportation Company, Buffalo, N. Y., is distributing a book of instructions (form 504) for care and operation of "Automatic" industrial trucks, tractors and engines; also bulletin No. 28, on its "Automatic" storage-battery industrial trucks, etc.

STORAGE BATTERIES. — The Electric Storage Battery Company, Philadelphia, has issued a small booklet (form 1483) giving instructions for installing and operating the "Ironclad-Exide" battery in storage-battery industrial tractors; also a small booklet entitled "Facts for Consideration in Selecting a Battery for Electric Industrial Truck and Tractor Service."

CONDULET FIXTURE JOINTS. — The Crouse-Hinds Company, Syracuse, N. Y., has issued bulletin 1,000R, covering its new types of condulet fixture joints and extensions.

MOTORS.—Howell Electric Motors Company, Howell, Mich., has issued bulletin No. 300, describing types A and B Howell polyphase motors.

SNAP SWITCH. — A new toggle-snap switch, No. 8171, single-pole, porcelain-base, surface type, made by Harvey Hubbell, Inc., Bridgeport, Conn., is described in bulletin No. 16-18.

METERS.—The Metric Appliance Corporation, 299 Broadway, New York City, has issued two folders describing respectively the "Mac" pocket ammeter and the "Mac" storage-cell tester.

WASHING MACHINES.—The One Minute Manufacturing Company, Newton, Iowa, is circulating an illustrated booklet on its various types of washing machines manufactured by the company.

LIGHTING FIXTURES.—The St. Louis Brass Manufacturing Company, St. Louis, has announced its annual catalog No. 8, for 1921, listing the types, sizes and prices of the lighting fixtures manufactured by the company.

QUARTZ LAMP AND ULTRA-VIOLET LIGHT.—The Cooper Hewitt Electric Company, 95 River Street, Hoboken, N. J., has issued bulletin 86, describing its laboratory outfit for Cooper Hewitt quartz-mercury-arc lamp as a source of ultra-violet light for bacteriological, chemical and industrial purposes as well as for research work. Technical bulletin No. 102 published by the company describes the Cooper Hewitt and ultra-violet light. Illustrations are also given showing energy distribution and transmission curves and energy distribution and reflectivity curves.

HEAVY OIL ENGINES.—The Dodge Sales & Engineering Company, Mishawaka, Ind., has published a small catalog describing its heavy oil stationary engines, heavy oil marine engines and heavy oil engine-driven electric generating units.

New Incorporations

THE ELECTRIC COMPANY OF DELAWARE has filed articles of incorporation under the laws of the State of Delaware to operate a central station. The incorporators are F. M. Holbrook, H. I. Conklin and J. J. Noel, all of Wilmington, Del.

THE INSTANTANEOUS ELECTRIC HEATER CORPORATION, Buffalo, N. Y., has been incorporated. by R. McLelland, A. E. Choate and J. G. Herb, all of Buffalo, N. Y. The company is capitalized at $500,000 and proposes to manufacture electric heaters.

THE SPECIAL MOTOR & MACHINE COMPANY, New York, N. Y., has been incorporated by F. F. Baum, J. W. Brautigan and C. R. Baird, 24 East Twenty-third Street, New York City. The company is capitalized at $30,000 and proposes to manufacture electrical and mechanical equipment.

THE BREVARD ELECTRICAL CORPORATION, New York, N. Y., has been incorporated by P. Brevard, F. L. and W. H. Reid, 128 Broadway. The company is capitalized at $200,000 and proposes to manufacture electrical equipment.

THE BEREGH MANUFACTURING CORPORATION, 461 Eighth Avenue, New York, N. Y., has been incorporated by I. J. Donovan, F. W. Saltzsieder and T. J. Beregh. The company is capitalized at $20,000 and proposes to do a general electrical and mechanical engineering business.

THE AUTOMATIC ELECTRIC HEATER COMPANY, Wilmington, Del., has been chartered with a capital stock of $600,000 by R. E. McCloskey, C. B. Cutten and S. L. Mackey, for the manufacture of electric heaters.

THE GRIFFITH SALES COMPANY, New York, N. Y., has been chartered with a capital stock of $50,000 to manufacture electrical and gas appliances. The incorporators are F. W. Doty, F. J. Page and J. H. Olsen, 1328 Broadway, New York City.

THE TIFFANY ELECTRIC COMPANY, East Orange, N. J., has been incorporated by Walter A. Morton, Harold Brabgs and Earl H. Tiffany, 422 North Walnut Street, East Orange. The company is capitalized at $30,000 and proposes to manufacture electrical specialties.

THE SHERMAN ELECTRIC COMPANY, Moro, Ore., has been incorporated with a capital stock of $200,000 by C. H. Howell, C. A. Buckley, R. H. McKean, A. M. Wright and N. W. Thompson.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 21, 1920)

1,362,587. PRINTING-TELEGRAPH RECEIVER; Edgar W. Adams, East Orange, N. J. App. filed Feb. 14, 1918. Receiving printer.

1,362,588. ELECTRIC SYSTEM OF DISTRIBUTION AND METHOD OF OPERATING THE SAME; Edwin W. Allen and Edward Taylor, Chicago, Ill. App. filed Sept. 8, 1919. Automatic prime-mover plant.

1,362,592. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Nov. 21, 1917. Duplex.

1,362,593. ELECTRICAL SYSTEM OF DISTRIBUTION; Thomas A. E. Belt, Schenectady, N. Y. App. filed April 16, 1920. Automatic hydro-electric plant.

1,362,596. SEMI-MECHANICAL TELEPHONE SYSTEM; William G. Blauvelt, New York, N. Y. App. filed April 11, 1917. Semi-automatic.

1,362,597. TRANSMITTER SUPPORT; William T. Booth, East Orange, N. J. App. filed Feb. 28, 1918. Breast plate.

1,362,605. SELECTING SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Dec. 29, 1916. For producing messages in different forms simultaneously.

1,362,607. TELEGRAPH SYSTEM; Andrew D. Dowd, Hoboken, N. J. App. filed March 29, 1918. Printing telegraph.

1,362,609. ELECTRIC HEATING APPARATUS; Raymond P. Dunning, Schenectady, N. Y. App. filed June 21, 1920. For heating rivets.

1,362,610. ELECTRIC HEATING APPARATUS; Raymond P. Dunning, Schenectady, N. Y. App. filed June 21, 1920. Rivet heater.

1,362,612. WIRELESS RECEIVING SYSTEM; Lloyd Espenschied, Hollis, N. Y. App. filed May 15, 1916. Protected from disturbing oscillations.

1,362,613. MEANS FOR NEUTRALIZING INTERFERING DISTURBANCES; Lloyd Espenschied, Hollis, N. Y. App. filed Dec. 5, 1918. For plurality of transmission circuits.

1,362,622. ELECTRIC HEATER; Allan B. Hendricks, Jr., Pittsfield, Mass. App. filed April 26, 1920. Induction type.

1,362,624. RAILWAY SIGNALING AND FREQUENCY SELECTIVE DEVICE FOR USE IN CONNECTION THEREWITH; John S. Holliday, Wilkinsburg, Pa. App. filed July 12, 1916.

1,362,637. ELECTRICAL SYSTEM OF DISTRIBUTION; Claude W. Place, La Grange, Ill. App. filed March 17, 1920. Automatic hydro-electric plant.

1,362,639. PRINTING MECHANISM; Paul M. Rainey, Glen Ridge, N. J. App. filed Nov. 3, 1917. Printing telegraph.

1,362,648. TELEGRAPH SYSTEM; Adolph R. Swoboda, Newark, N. J. App. filed April 22, 1918. Leak-nullifying means.

1,362,663. COMMUTATOR; Thomas Zimmerman, Niagara Falls, N. Y. App. filed April 17, 1914. To withstand high speeds and temperatures.

1,362,674. SWITCH-BOX MOUNTING; Nils T. Clements, Superior, Wis. App. filed June 17, 1919. Mounted in walls.

1,362,734. LAMP HOLDER OF THE EDISON TYPE; Antonio Piazzi, Gallarate, Italy. App. filed Aug. 19, 1918. Readily taken apart.

1,362,737. SEPARATOR FOR STORAGE-BATTERY PLATES; George W. Pleis, Philadelphia, Pa. App. filed July 23, 1919. Will not warp.

1,362,770. ELECTRICAL APPARATUS FOR INTERNAL-COMBUSTION ENGINES; Joseph Bijur, New York, N. Y. App. filed Nov. 24, 1915. Starting motor.

1,362,771. ELECTRICAL APPARATUS FOR AUTOMOBILES AND THE LIKE; Joseph Bijur, New York, N. Y. App. filed Oct. 16, 1916. Dynamo.

1,362,772. ACCESSORY FOR MOTOR VEHICLES; Joseph Bijur, New York, N. Y. App. filed Aug. 10, 1917. Dynamo-electric machine.

1,362,794. ART OF CHARGING STORAGE BATTERIES; Arthur H. Hoffman, Ames, Iowa. App. filed April 3, 1917. Driven by small windmill.

1,362,842. GYRO-COMPASS; Sidney G. Brown, North Acton, England. App. filed Feb. 12, 1920. Repeaters.

1,362,844. SYSTEM OF ELECTRICAL DISTRIBUTION; John B. N. Cardoza, Virginia Beach, Va. App. filed Oct. 17, 1919. Battery control.

1,362,876. SYNCHRONIZING APPARATUS; Ladislav O. Kozar, Middletown, Pa. App. filed Jan. 30, 1917. Maintains synchronism.

1,362,892. TOILET ARTICLE; Elmira Page, Louisville, Ky. App. filed Aug. 17, 1920. Electrically heated comb, curling tongs, etc.

1,362,898. ELECTRIC CONTROLLING MEANS; William Schwagermann, Yonkers, N. Y. App. filed April 25, 1916. For controlling storage-battery system.

1,362,906. COMBINATION FIXTURE HANGER AND CONCEALED SWITCH HOLDER; Wallace R. Wallick, Lincoln, Neb. App. filed Aug. 18, 1919. For lighting fixtures.

1,362,921. LIGHTING SYSTEM; FOR AUTOMOBILES; Henri J. Bourbonnier, Montreal, Quebec, Can. App. filed May 10, 1916. Lamps in series or parallel.

1,362,959. POLYPHASE INDUCTION MOTOR; John B. Price, Fort Thomas, Ky. App. filed Nov. 7, 1918. High starting troque and low starting current.

1,362,962. ELECTRIC WELDING MACHINE; Cleveland Redfield and Charles C. Hartley, Ogden, Utah. App. filed April 15, 1919. Spot-welding plates or sheets.

1,362,992. WATER-TIGHT PLUG AND RECEPTACLE; John W. Haywood, New York, N. Y. App. filed Feb. 27, 1919. Used on ship.

1,363,000. OZONIZER; William G. Lindemann, Milwaukee, Wis. App. filed Aug. 4, 1919. Generating ozone from stream of compressed air.

1,363,019. ELECTRIC LAMP FIXTURE; Ralph H. Sheldrick, Waterbury, Conn. App. filed June 26, 1920. Wall bracket.

1,363,032. WIRELESS SYNCHRONIZER; Ernest Bancroft, Sonoma, Cal. App. filed Dec. 19, 1919. For timing oscillations.

1,363,037. METHOD OF AND MEANS FOR PRODUCING ELECTRIFIED JETS OF GAS; Robert H. Goddard, Worcester, Mass. App. filed Oct. 4, 1917. Change in velocity will not affect.

1,363,052. TREATMENT OF ZINC SOLUTIONS; Frederic Petersson, Balham, England. App. filed July 13, 1920. Electrolytic.

1,363,074. METHOD OF INSULATION FOR HEATING DEVICES; John J. Zwerling, San Francisco, Cal. App. filed May 20, 1920. Insulating coating.

1,363,078. PROPELLING MEANS FOR BOATS; Asher R. Bauer, Allentown, Pa. App. filed June 2, 1919. Contact rail on bank.

1,363,108. ELECTRIC STOVE; Hugh W. Gasaway, East Pleasant Plain, Iowa. App. filed June 15, 1920. For toasting bread.

1,363,124. LIGHTNING ARRESTER; Thomas L. Keller, Bristol, Pa. App. filed May 8, 1919. Prevents lightning from leaving main line.

1,363,132. FLASHLIGHT; Thomas E. Lander and John Hauenstein, Kansas City, Mo. App. filed Jan. 2, 1920. Attachment for holding one or more.

1,363,156. METHOD OF ELECTRICALLY WELDING TOGETHER THE EDGES OF THIN METAL PLATES; Thomas E. Murray, Brooklyn, N. Y. App. filed July 3, 1920. To prevent relative displacement.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LITTLETON, N. H.—The White Mountain Novelty Company plans to build a woodturning factory and a power plant. A. A. Pennock is manager.

Middle Atlantic States

BOSTON, N. Y.—The State Public Service Commission has authorized the Depew & Lancaster Light, Power & Conduit Company, Lancaster, to construct an electric plant at this place.

BUFFALO, N. Y.—The City Council is considering the installation of electrically operated, high-tension, pumping equipment at the Colonial Ward pumping station in connection with the fire department. The cost is estimated at about $400,000.

COLDEN, N. Y.—The Depew & Lancaster Light, Power & Conduit Company, Lancaster, has applied to the State Public Service Commission, Second District, for permission to construct and operate an electric light, heat and power plant in Colden.

NORTH TONAWANDA, N. Y.—The Tonowanda Power Company contemplates the extension of its lines in the Witmer Road section. E. F. King is manager.

HOPEWELL, N. J.—The Borough Council has plans under way for improvements to the street-lighting system.

JERSEY CITY, N. J.—The Board of Commissioners, Hudson County, has plans under way for improvements and extensions to the county electric light and power plant at Snake Hill. T. J. Wasser is county engineer.

JERSEY CITY, N. J.—The Fulton Terminal Lumber Company, recently organized with a capital of $1,000,000, contemplates the erection of a lumber plant and power house. Plans also include the installation of electric motors, motor drives for woodworking, etc. B. F. Fitch, 61 Broadway, New York City, is interested.

LAKEHURST, N. J.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the establishment of a signal system, also an electric distribution system, including a series street-lighting system with underground ducts, street-lighting standards, transformers, etc. (Specification 4348).

ALTOONA, PA.—Petitions are being circulated for extensions to the street-lighting system on various streets of the city.

HARRISBURG, PA.—The City Council is arranging an appropriation of $16,959 for the municipal electric bureau to be used for underground line extensions, installation of street lamps, etc.

LEWISTOWN, PA.—The Penn Central Light & Power Company has plans under way for the erection of a transmission line on West Hale Street.

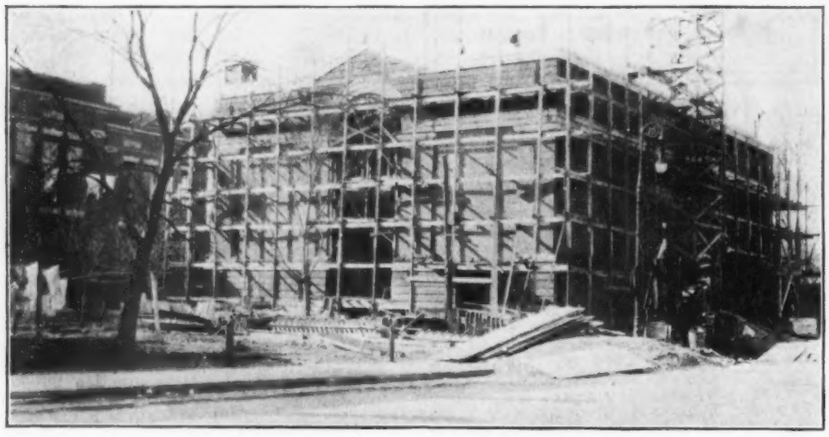
MILLVALE, PA.—The Duquesne Light Company, Pittsburgh, has purchased the borough electrical plant, and according to terms of the sale will install modern equipment. The light company is also considering the installation of an ornamental street-lighting system.

PHILADELPHIA, PA.—The Mayor recently signed an ordinance providing for the substitution of incandescent electric lights for 1,062 gasoline and ten gas lamps in the Twenty-third and Thirty-fifth Wards.

PHILADELPHIA, PA.—The Department of City Transit, Chestnut Street, has plans under way for the erection of a number of electric plants for the operation of the Frankford elevated railway system. W. S. Twining is director of city transit.

BALTIMORE, MD.—The Department of Lamps and Lighting contemplates the installation of an ornamental street-lighting system on Columbia Avenue, Harford Road, Hanover Street and a number of other main thoroughfares during the coming year. J. J. Hanson is superintendent of the department.

BALTIMORE, MD.—It is understood that the United Railways & Electric Company has plans under way for the construction of a new electric substation.



UNITED ELECTRIC COMPANY, SPRINGFIELD, MASS., SUBSTATION UNDER CONSTRUCTION

BOONSBORO, MD.—The Hagerstown & Frederick Railway Company, Hagerstown, is arranging for the Antietam Light & Power Company, Fairplay, to distribute power to Boonsboro, Keedysville and Sharpsburg.

HARRISONBURG, VA.—The board of directors of the Rockingham Memorial Hospital contemplate the erection of a new power house at the institution. C. M. Robinson, Times-Dispatch Building, Richmond, is architect.

North Central States

SAULT STE. MARIE, MICH.—The city officials plan to extend the lighting system on Portage Avenue. T. J. Watchorn is commissioner.

IRVINE, KY.—The Irvine Light & Power Company contemplates the expenditure of $10,000 for improvements to its plant.

FRANKFORT, IND.—The City Council has authorized an issue of $175,000 bonds for the erection of a municipal light plant.

FREEBURG, ILL.—The City Council contemplates the erection of an electric lighting plant in the spring to cost about $30,000. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

OLNEY, ILL.—The board of directors of the Olney Sanitarium are having plans revised for the construction of a new power house at the institution in connection with a new hospital building. The cost is estimated at about $100,000. L. H. Osterhage and B. Sutton, Second National Bank Building, Vincennes, Ind., are architects.

SPRINGFIELD, ILL.—The City Council plans to install an ornamental street-lighting system in the downtown section and place underground wiring in the business district.

MANITOWAC, WIS.—The Manitowac Shipbuilding Company, Sixteenth Street, will soon award the contract for the erection of a round house and power house on Eighth Street, to cost about $75,000.

HEIBERG, MINN.—The J. F. Heiberg Electric Light & Power Company contemplates repairs to its plant and dam at this place. The company also plans to extend a transmission line to Ada.

MINNEAPOLIS, MINN.—The city officials are awaiting legislative action in regard to the construction of a 375-hp. power plant on the Mississippi River for the operation of an ice plant to be erected at this place.

WORTHING, S. D.—The town board has been petitioned to issue $12,000 in bonds for the erection of a transmission line to Harrisburg to connect with lines from Sioux Falls.

MINATARE, NEB.—The city officials contemplate the purchase of electric motors, two centrifugal pumps, gas engines, etc., to cost about $40,292. R. O. Chambers is city clerk.

Southern States

LEESBURG, FLA.—The Grass Fiber Pulp & Paper Company contemplates the installation of an electric light and power plant.

ST. PETERSBURG, FLA.—The St. Petersburg Electric Company contemplates extension to the street-lighting system.

ST. PETERSBURG, FLA.—The Williams-Beers Ice Company contemplates the erection of an electrically operated ice manufacturing plant to cost about $100,000. H. Beers is engineer.

MONROE, LA.—A proposition to issue $140,000 in bonds will be submitted to the voters for completing the erection of the electric light, power and water works system.

ST. JOSEPH, LA.—Bonds to the amount of $20,000 have been voted for the installation of an electric light plant.

AMARILLO, TEX.—The Fort Worth & Denver City Railroad Company is having plans prepared for the installation of a new turntable and power plant, etc., at this place, to cost about $100,000.

CHILDRESS, TEX.—The Fort Worth & Denver City Railroad Company is having plans prepared for the erection of a power plant, extension to yards, addition to machine shops, etc., in Childress, to cost about $500,000.

FORT WORTH, TEX.—The Fort Worth & Denver Railroad Company, F. E. Clarity, vice-president and general manager, Denver Record Building, is having plans prepared for enlarging power plant, replacing present turntable with a 90-ft. turntable, etc., at a cost of about $150,000. R. C. Gowdy, Denver, Col., is chief engineer.

Pacific and Mountain States

OROVILLE, CAL.—The Hutchinson Lumber Company contemplates the erection of an electric power plant in connection with its new mills, estimated to cost in excess of $1,000,000. C. O. Griffith is in charge.

MATHESON, COL.—The Farmers' Electric Light, Power & Coal Company, recently incorporated for $100,000, contemplates the erection of a power plant at this place, to furnish light and power to four adjoining towns. O. M. White, president of the State Bank of Matheson, heads the company.

Canada

LONDON, ONT.—The Public Utilities Commission, Hydro Building, contemplates the erection of a substation at East London to cost about $35,000. Transformers, lightning arresters, etc., will be required. E. V. Buchanan, Hydro Building, London, is engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the General Purchasing Office of the Panama Canal, Washington, D. C., until Jan. 17 for furnishing one voltmeter and 5,000 ft. of high-tension ignition cable to be 19 No. 27 A.W.G. tinned wires, stranded, single conductor and of three-layer insulation.